



16th International Radiance Workshop / 8.21-25.2017 / Portland
Kevin G. Van Den Wymelenberg, PhD, IES





UNIVERSITY
OF OREGON

Kevin Van Den Wymelenberg



@Wymelenberg
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TALLWOOD
DESIGN INSTITUTE

OUR CURRENT TEAM

Full Time

1. Ashkaan Fahimipour
2. Sue Ishaq
3. Jeff Kline
4. Stephanie Luire
5. Alen Mahic
6. Alejandro Manzo
7. Dale Northcutt
8. Jason Stenson
9. Roo Vandegrift
10. Hannah Wilson

Co-PI

1. G.Z. Brown – UO
2. Jessica Green – UO
3. Chris Minson – UO
4. Susan Sokolowski - UO
5. E. Hartmann – Northwestern
6. C. Huttenhower - Harvard
7. R.Halden – ASU
8. D. Johnson-Sheltin - ORI
9. M. Riggio – OSU
10. A. Barbosa – OSU
11. F. Laleicke - OSU



Part-time / Students

1. Ashley Bateman
2. Denise Blankenberger
3. Nathan Brown
4. Victoria Carroll
5. Rachel (Richaro) Cui
6. Daniel Hundley
7. Serena Lim
8. Andrew Loia
9. Ryan McGowan
10. Gwynne Mhuireach
11. Amir Nezamdoost
12. Daniel Roth
13. Maria Sarao
14. Paul Ward



ESBL @ UO since 1977!

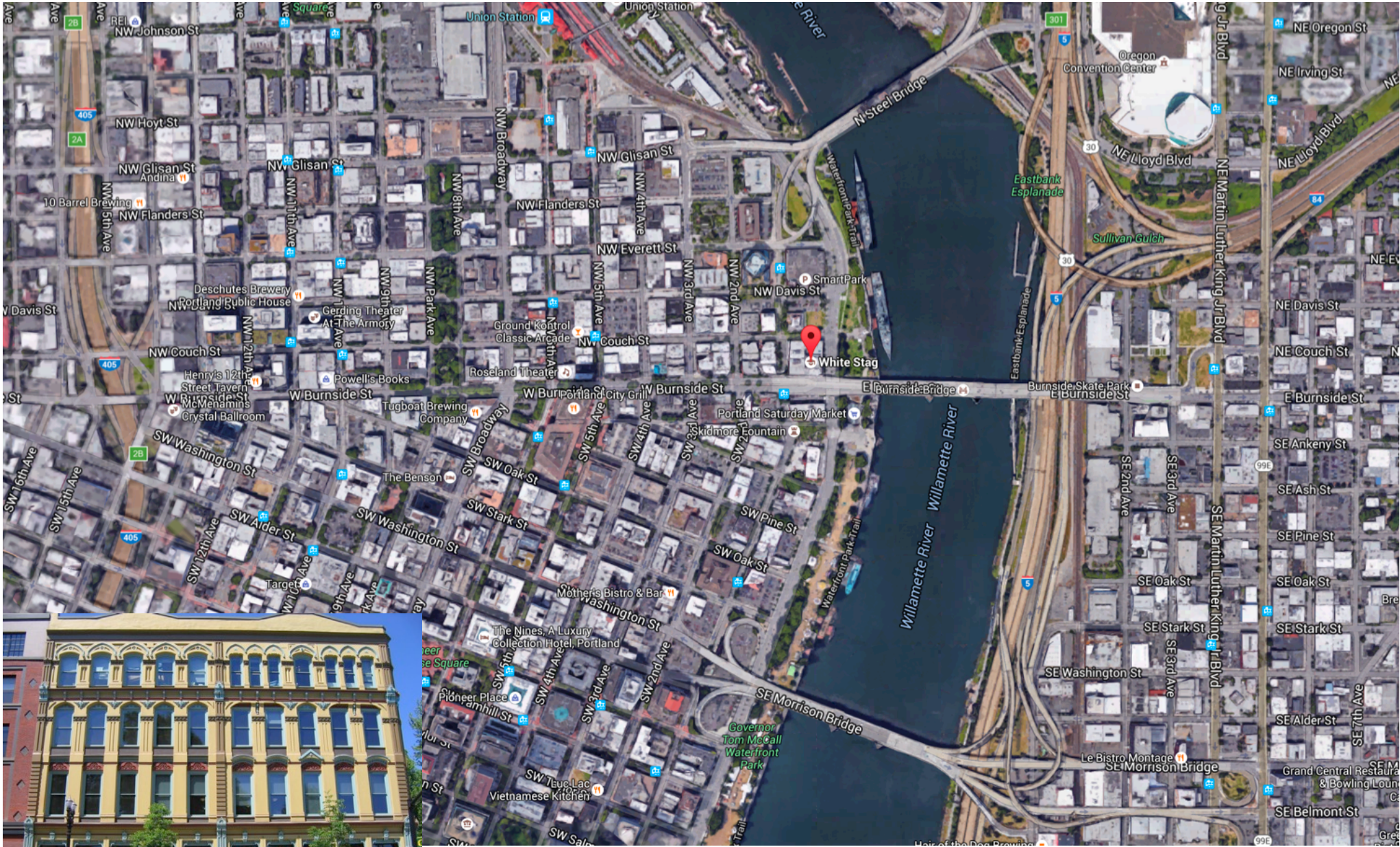
thank you GZB



eugene



portland



> research < > practice <

thank you SRG. UI-IDL

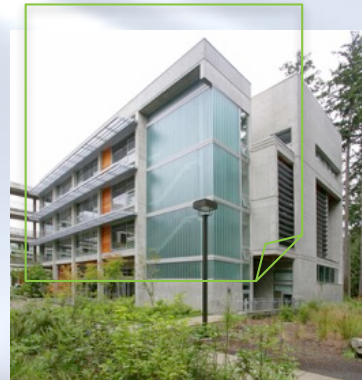
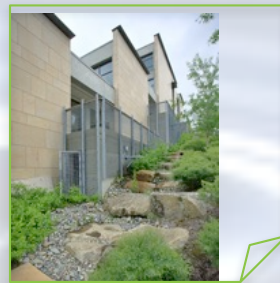
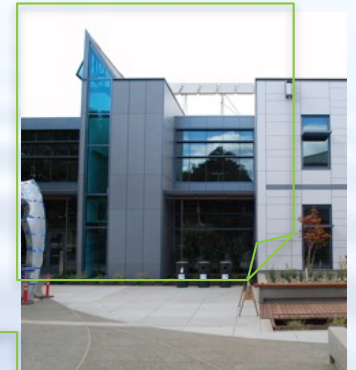
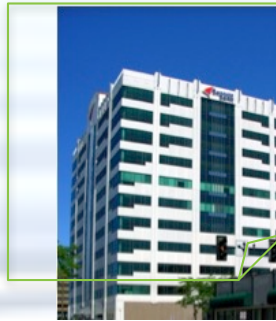
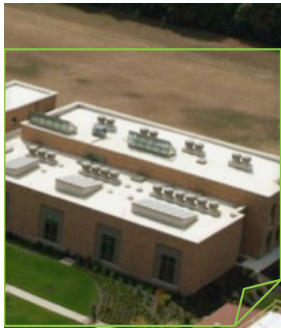
thank you NEEA

daylighting market transformation

via project-based education

- 50M ft² consulted
- 45.3 aMW (electric)

- 625 buildings consulted
- 50 buildings saved > 50%



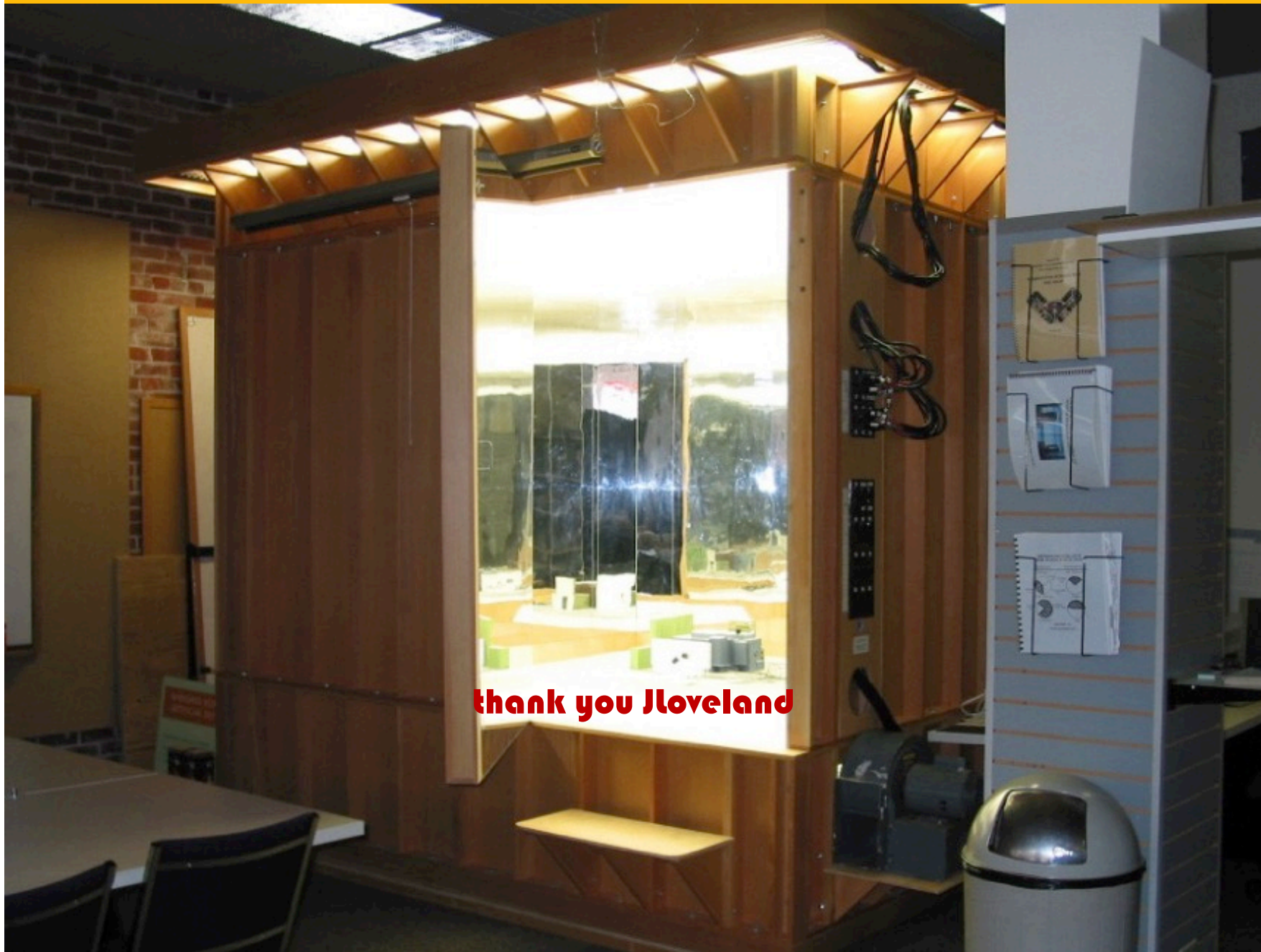
2000-2010





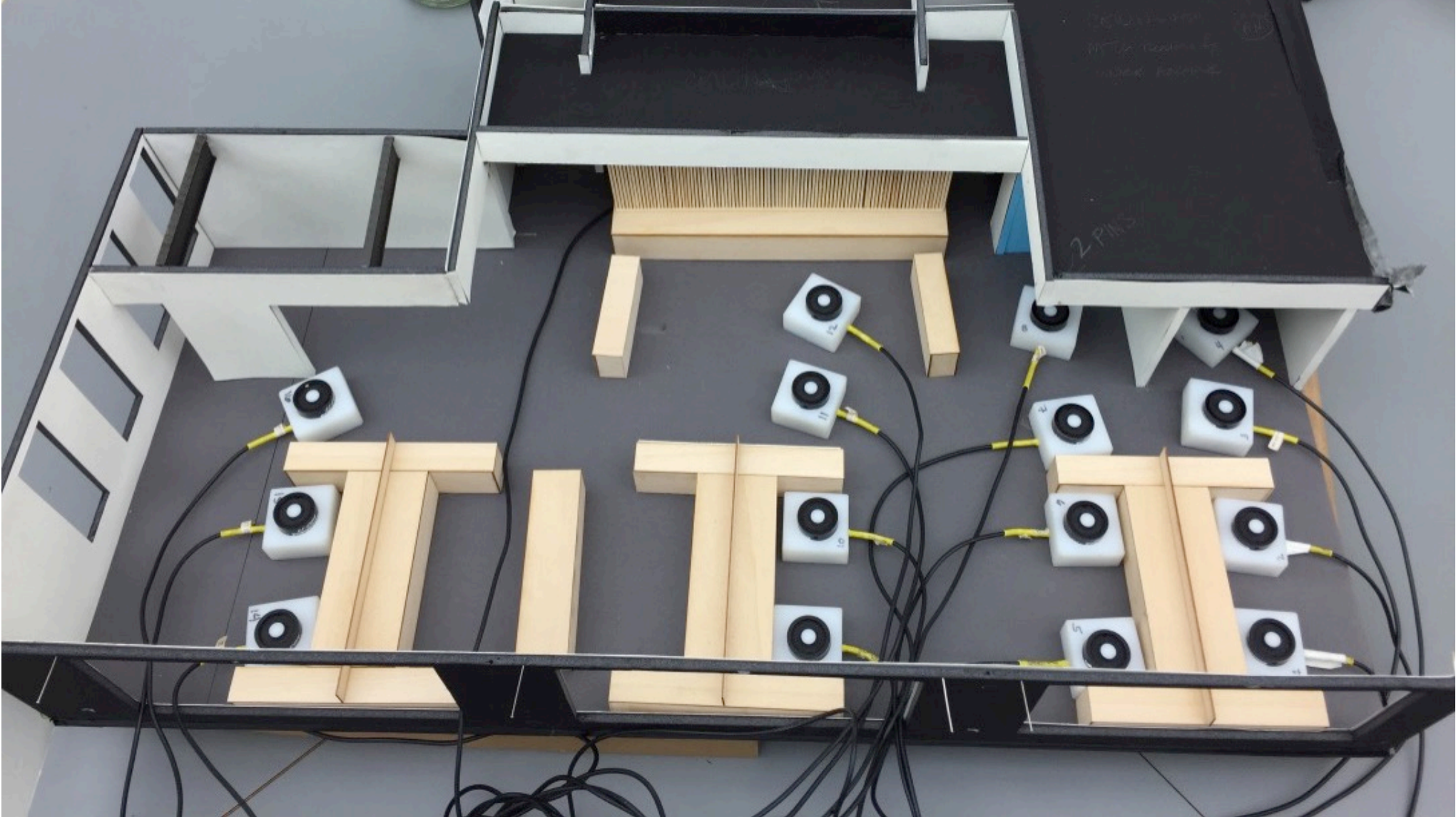
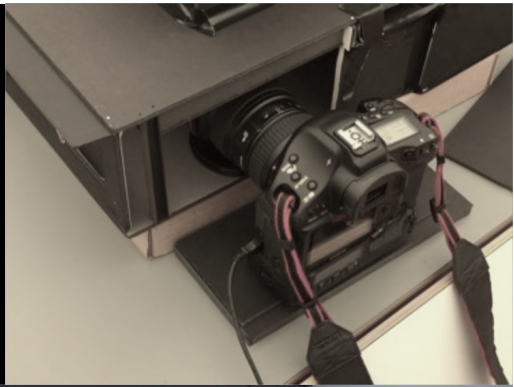
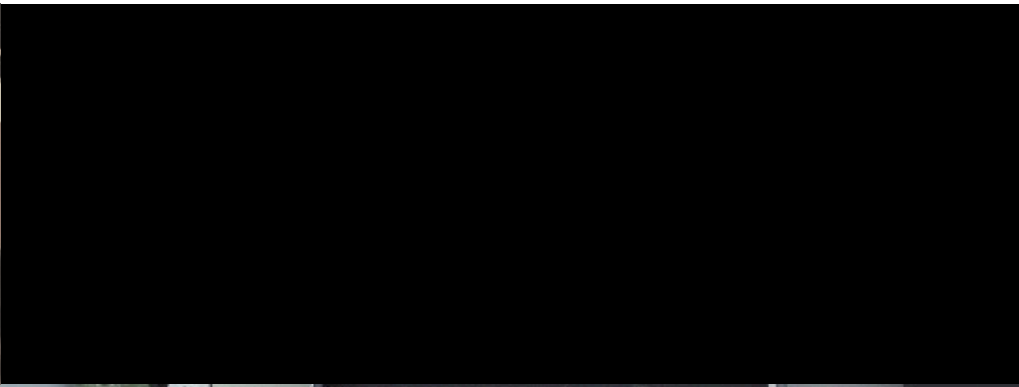
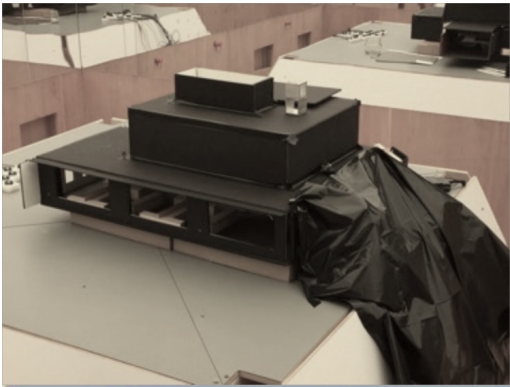


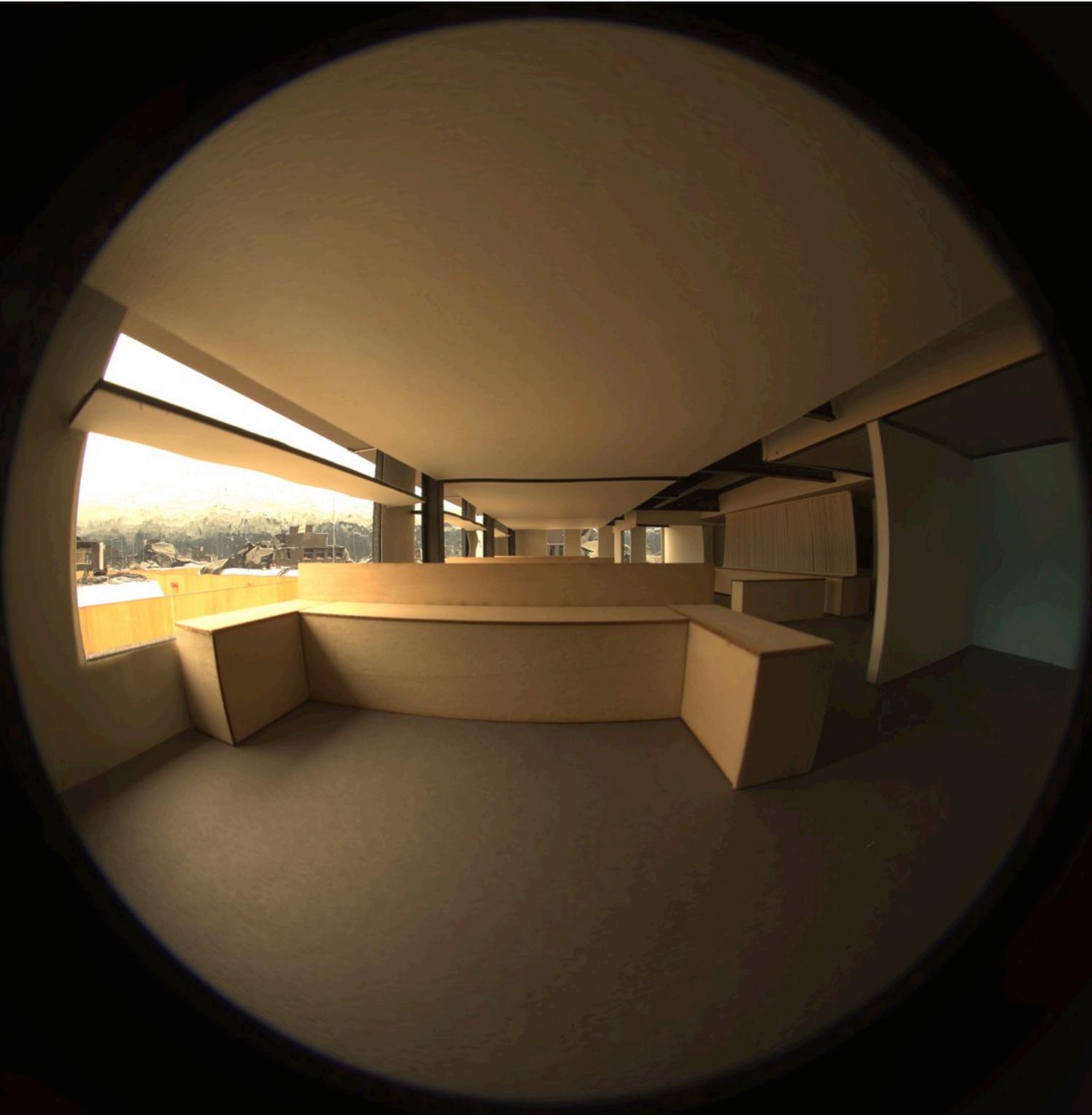
overcast sky simulator

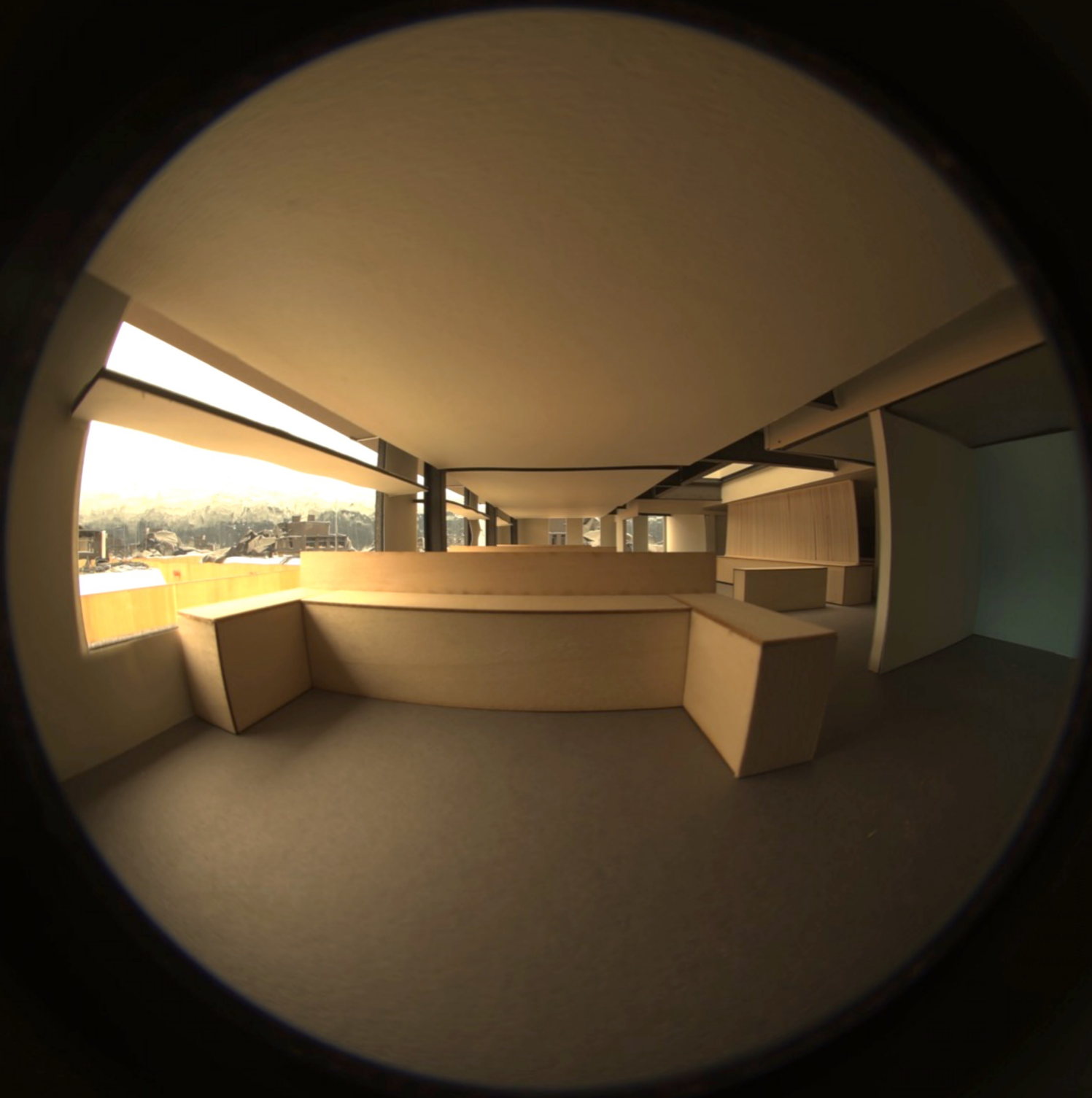


thank you Jloveland

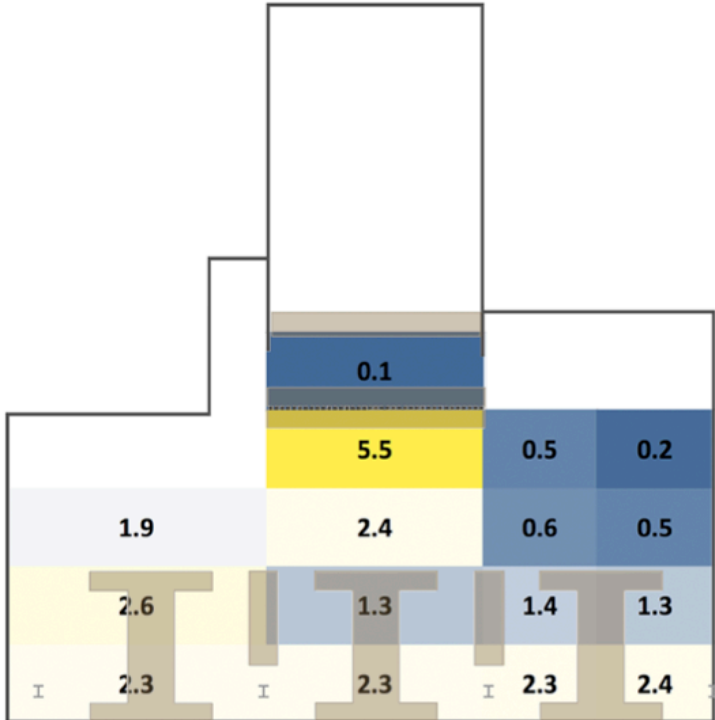
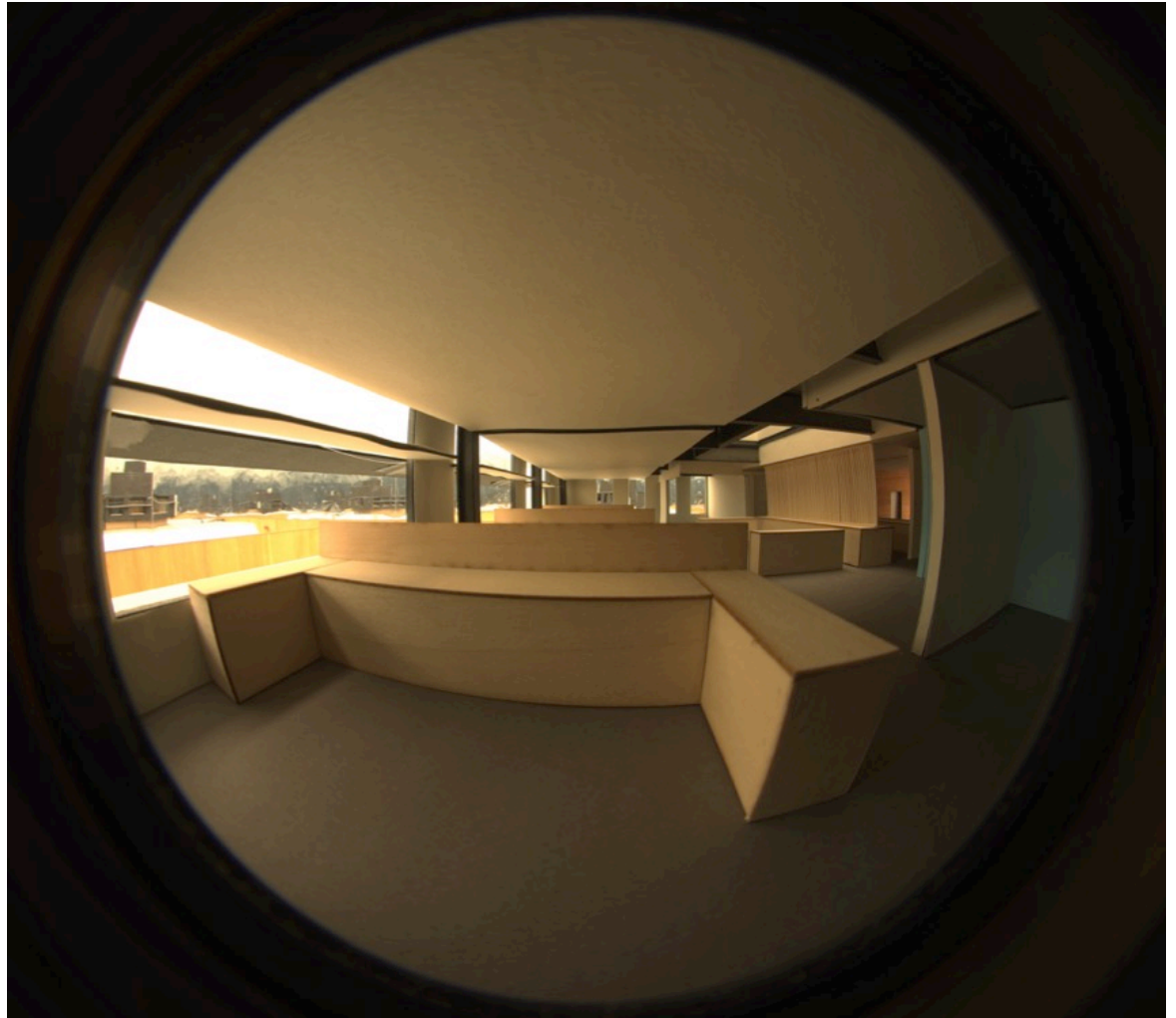
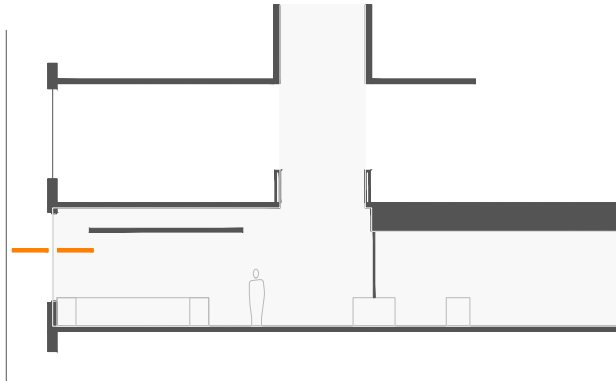








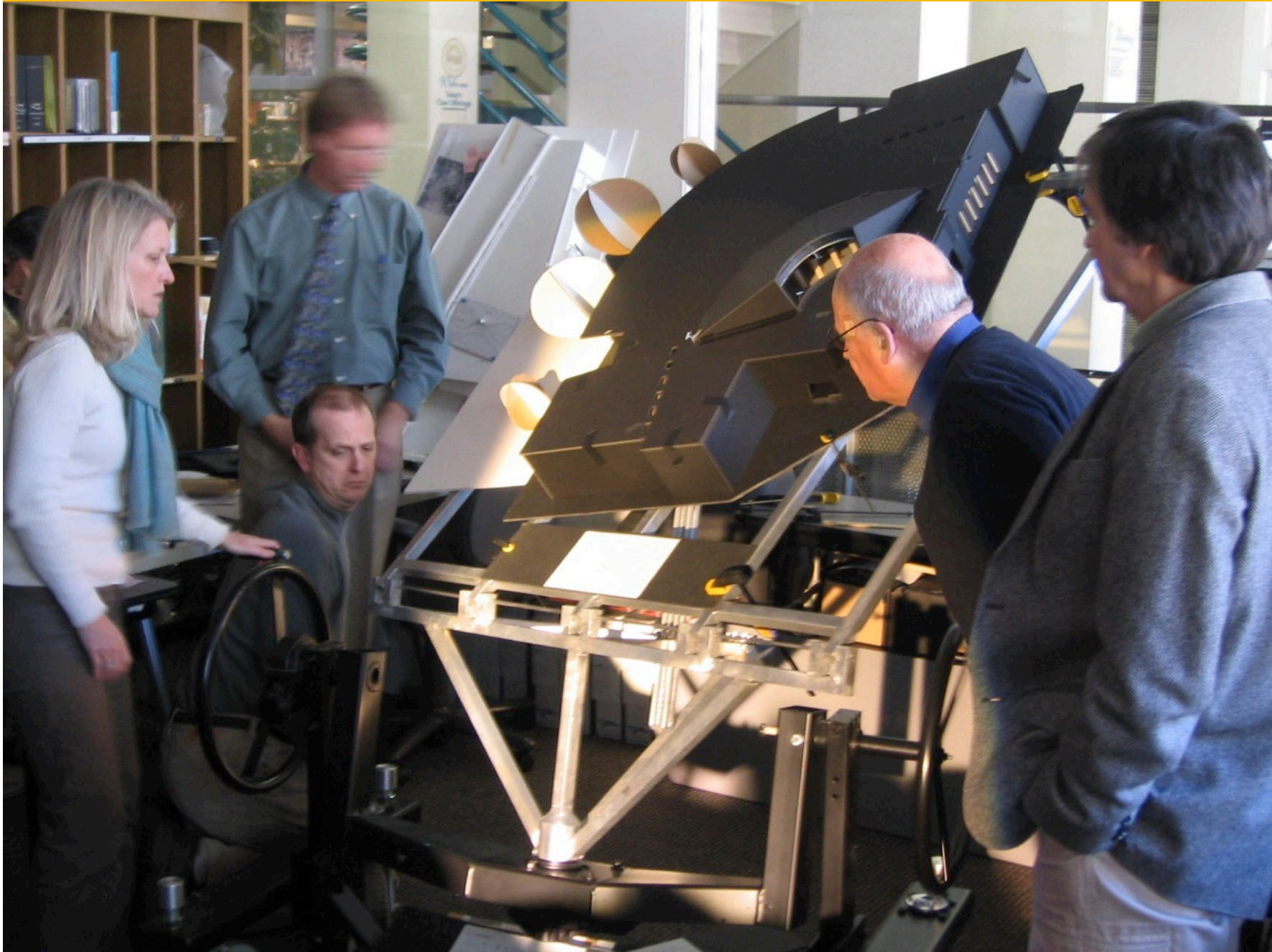
Case A: Overhang at 8', Light Shelf at 8', W/ Skylight



Daylight Factor
(Ratio of Outdoor Illuminance Indoors – Overcast Sky)



heliodon solar simulator





September 21
Daylight Time

thank you UW



digital daylight simulation

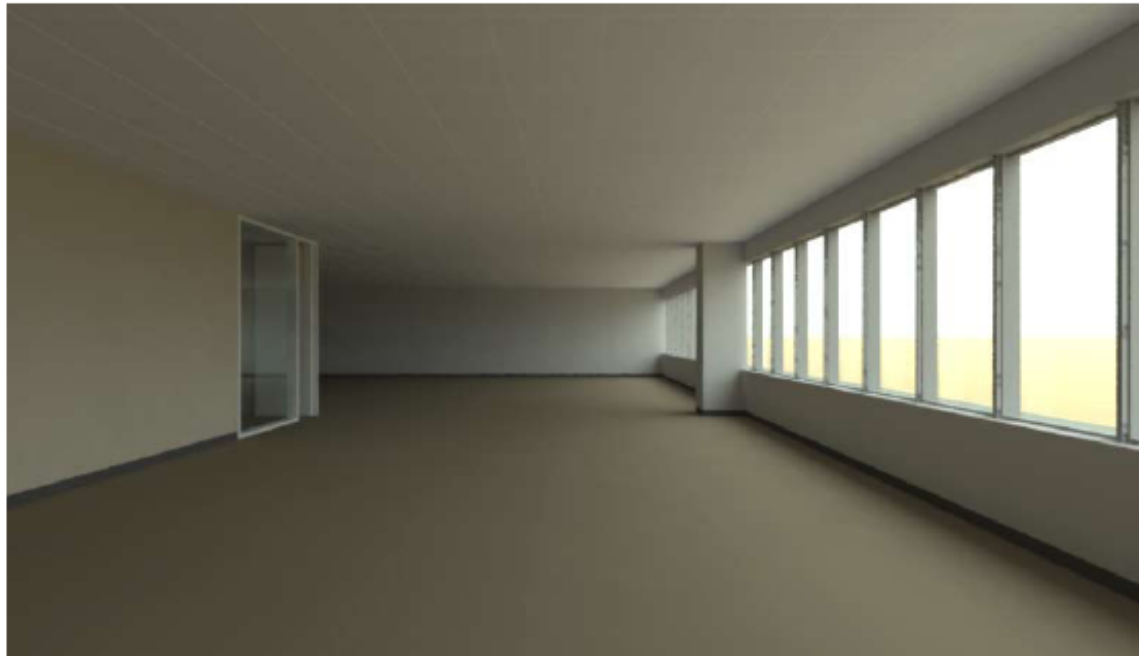
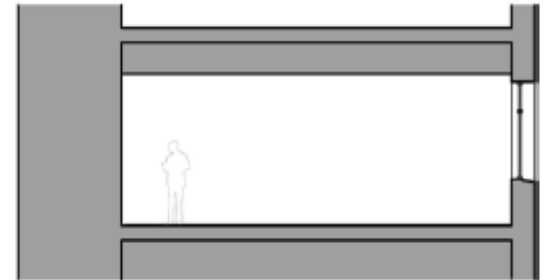
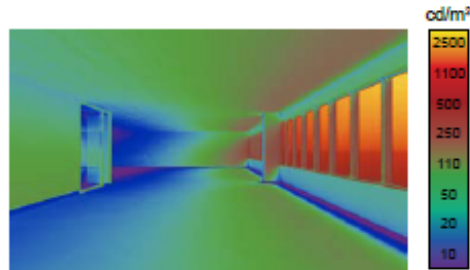


thank you Allubof

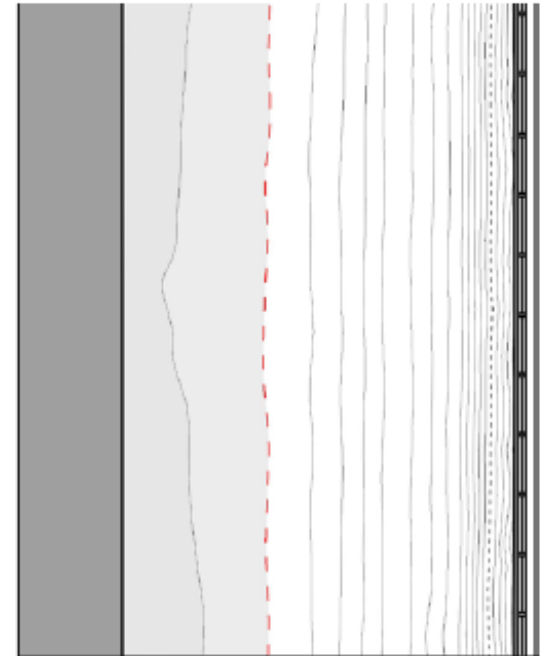
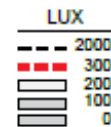
Pattern 5.1: Interior Furniture Layout

Open Volume

A horizontal band of windows at 40 percent of the opaque wall area provides daylight illumination that meets or exceeds commonly accepted minimum daylight illumination criteria at approximately 75 percent of the adjacent 26'-0" deep open office area.



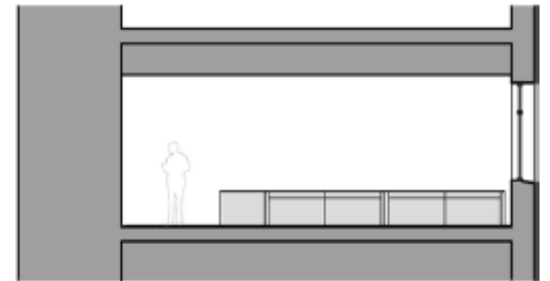
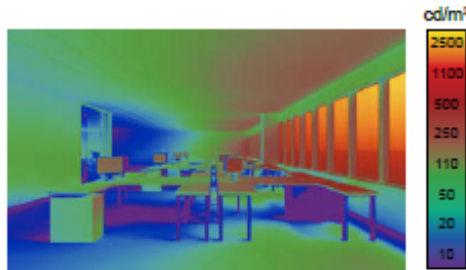
75%
of floor area is
above 300 lux



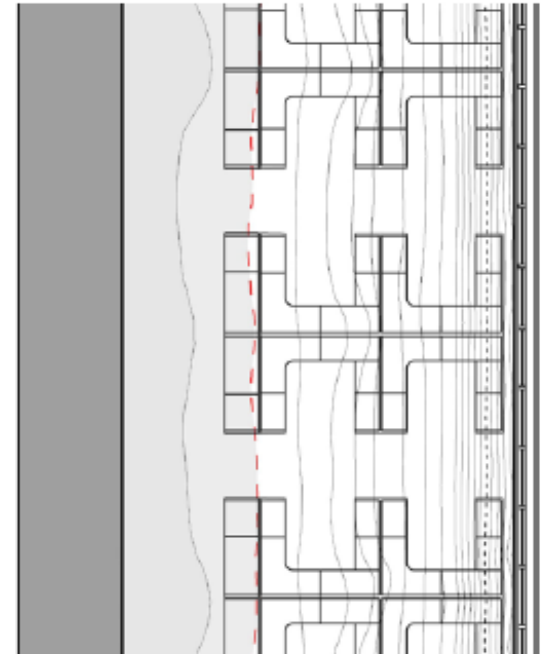
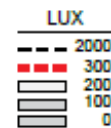
Pattern 5.2: Interior Furniture Layout

Desks Only

The inclusion of "open" desk workstations has limited impact on the daylight distribution across the horizontal workplane. Daylight levels exceed commonly accepted ambient illumination criteria at all areas except at the circulation aisle (at left).



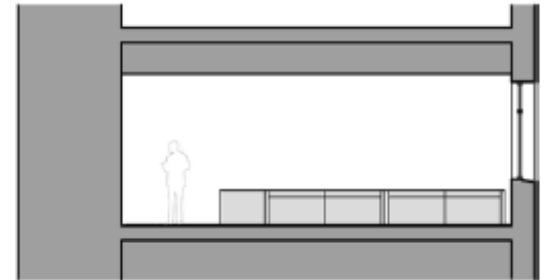
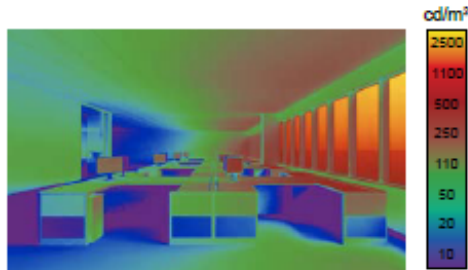
75%
of floor area is
above 300 lux



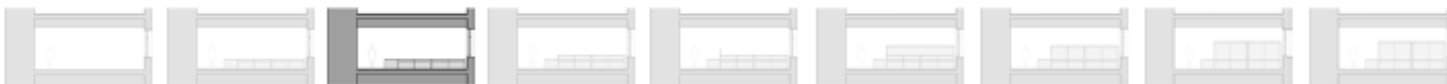
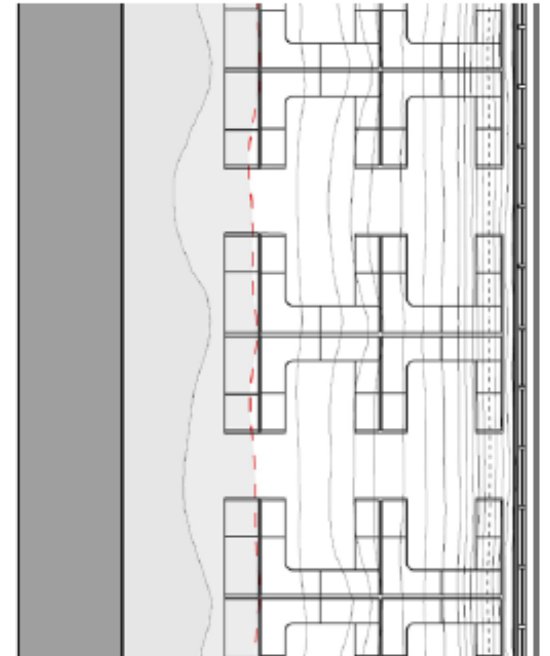
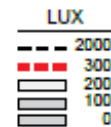
Pattern 5.3: Interior Furniture Layout

Low Panels

The inclusion of modesty panels below the 30" desk height has virtually no impact on the daylight distribution across the horizontal workplane. Daylight levels exceed commonly accepted ambient illumination criteria at all areas except the circulation aisle (at left).



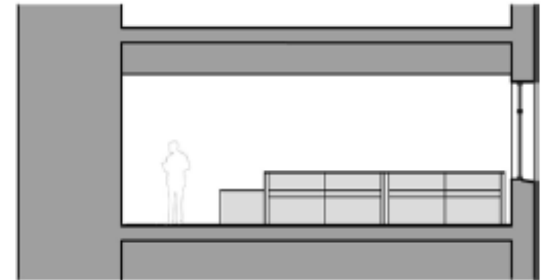
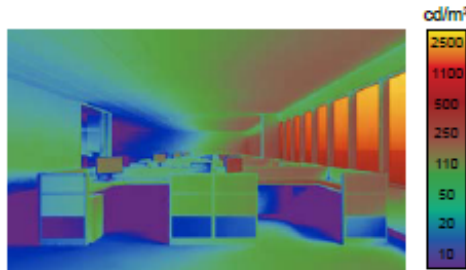
75%
of floor area is
above 300 lux



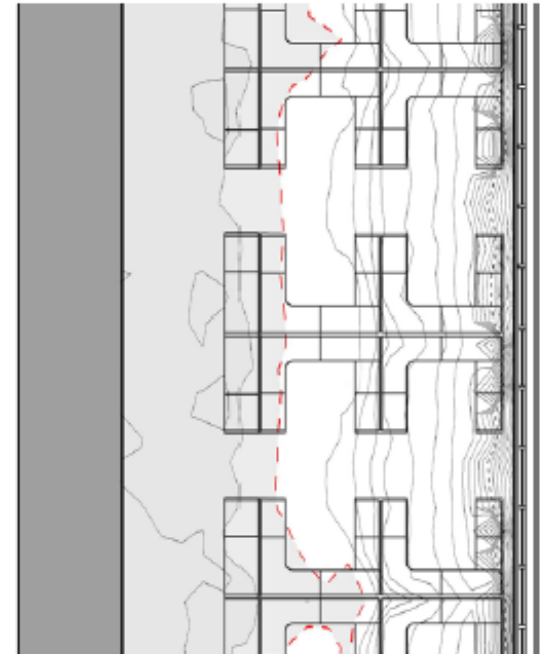
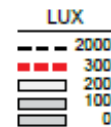
Pattern 5.4: Interior Furniture Layout

42" Panels

The inclusion of 42" panels begin to create some shadowing at the horizontal workplane. However, ceiling brightness begins to diminish as the reflectance off of the floor and desk surfaces is reduced by the panels. Daylight levels continue to exceed commonly accepted ambient illumination criteria at nearly all workstations.



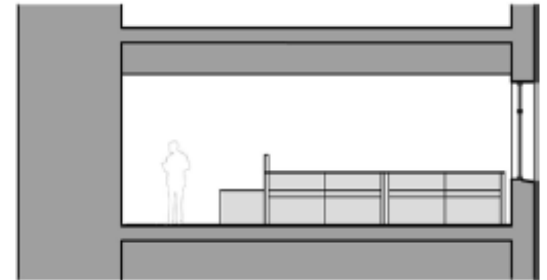
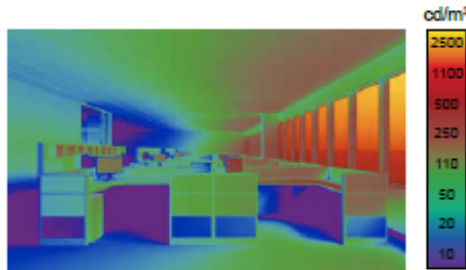
65%
of floor area is
above 300 lux



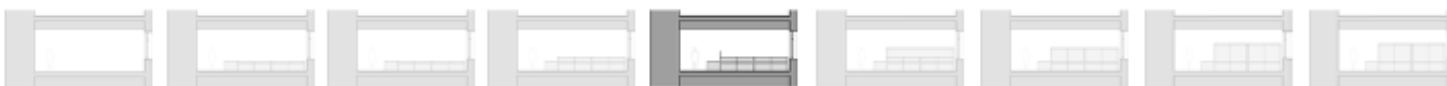
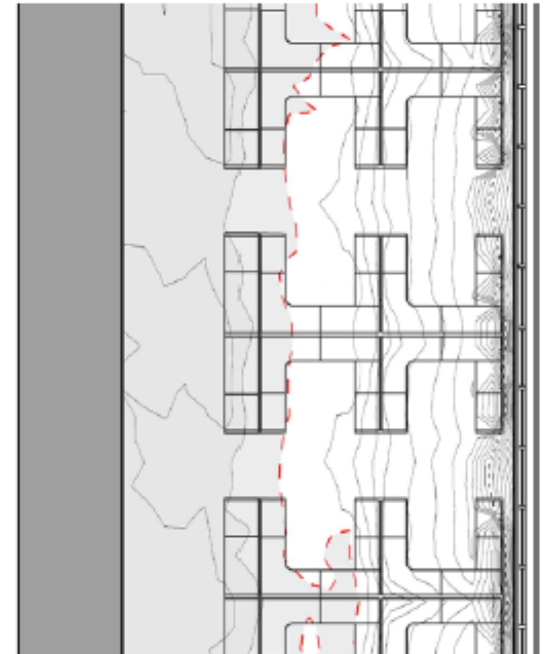
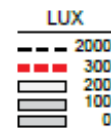
Pattern 5.5: Interior Furniture Layout

42" Panels with Glass Partition (As-Built)

The addition of a glass partition between the aisle and the workstation area increases acoustic privacy while maintaining brightness at the "back" wall (at left). Horizontal daylight levels continue to exceed commonly accepted ambient illumination criteria at nearly all of the workstation areas.



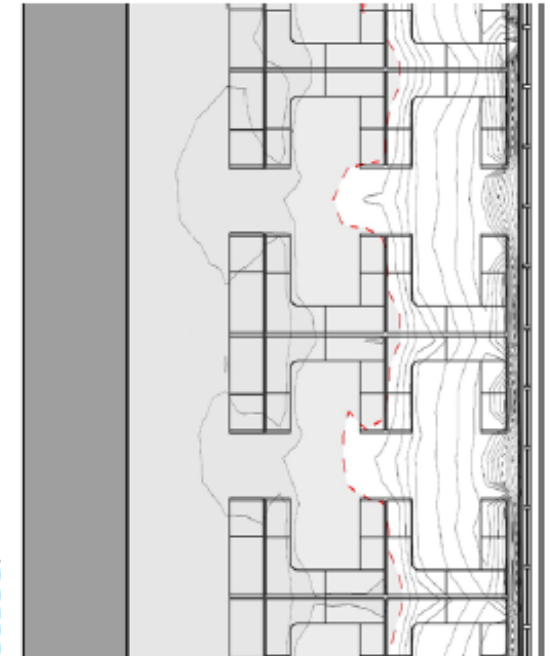
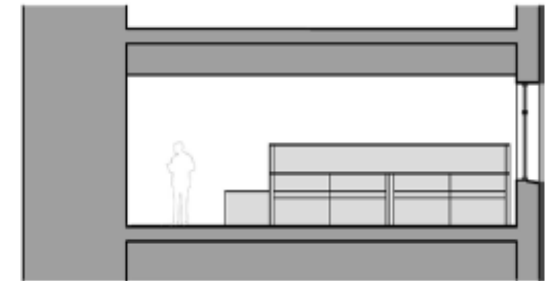
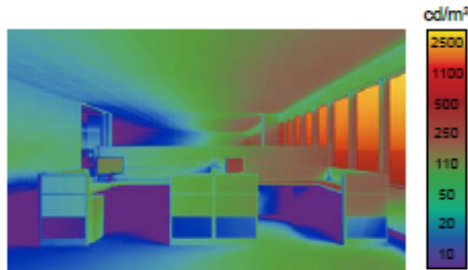
60%
of floor area is
above 300 lux



Pattern 5.6: Interior Furniture Layout

42" Panels with 60" Panels Perpendicular to Glazing

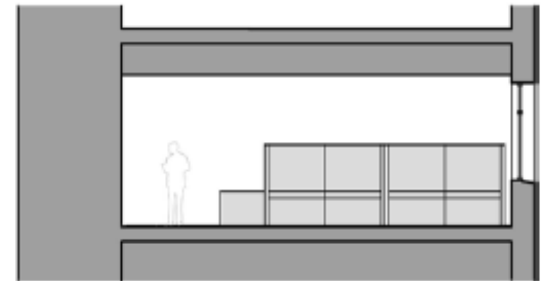
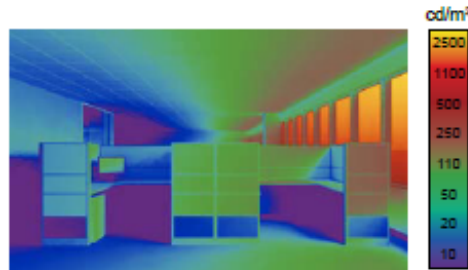
The addition of a 60" panel perpendicular to the window wall, increases both visual and acoustic privacy. Though diffuse daylight levels are reduced, views to the exterior remain largely unobstructed. Horizontal daylight levels continue to exceed commonly accepted ambient illumination criteria at 50 percent workstations.



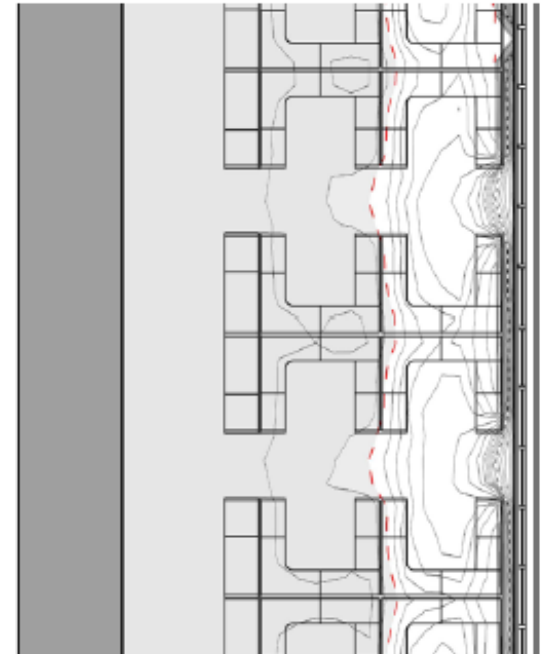
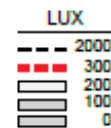
Pattern 5.7: Interior Furniture Layout

60" Panels

The addition of 60" panels surrounding all workstations substantially reduce daylight levels at the back wall and beyond the workstations directly at the perimeter. Views to the exterior are constrained dramatically at all workstations. Horizontal daylight levels exceed commonly accepted ambient illumination criteria only directly adjacent to the perimeter glazing.



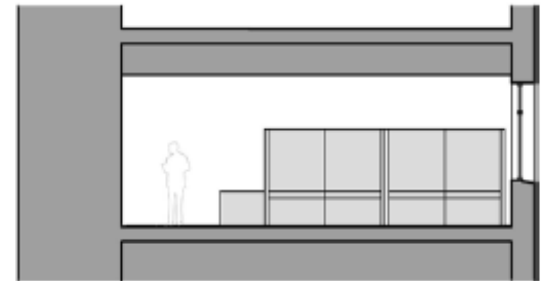
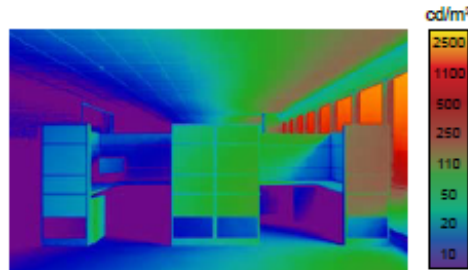
35%
of floor area is
above 300 lux



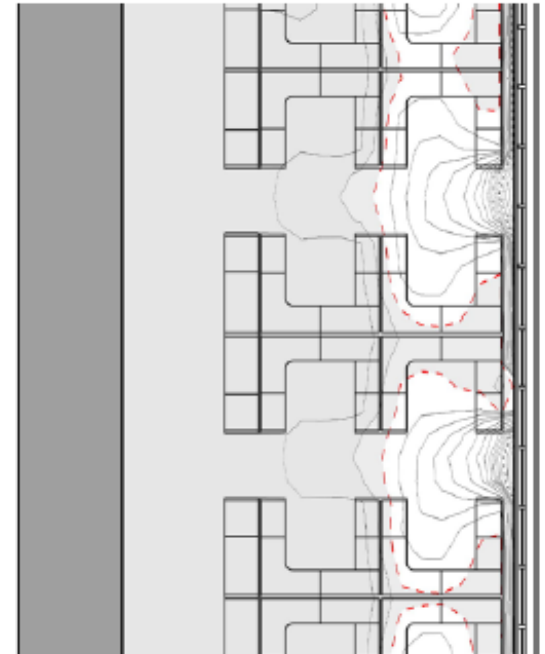
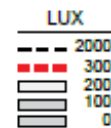
Pattern 5.8: Interior Furniture Layout

72" Panels

72" panels surrounding all workstations reduce daylight levels even further, especially at the back wall. Even the perimeter workstations are marginally daylight. Views to the exterior are constrained dramatically at all workstations. Horizontal daylight levels exceed commonly accepted ambient illumination criteria only at aisle ways directly adjacent to the perimeter glazing.



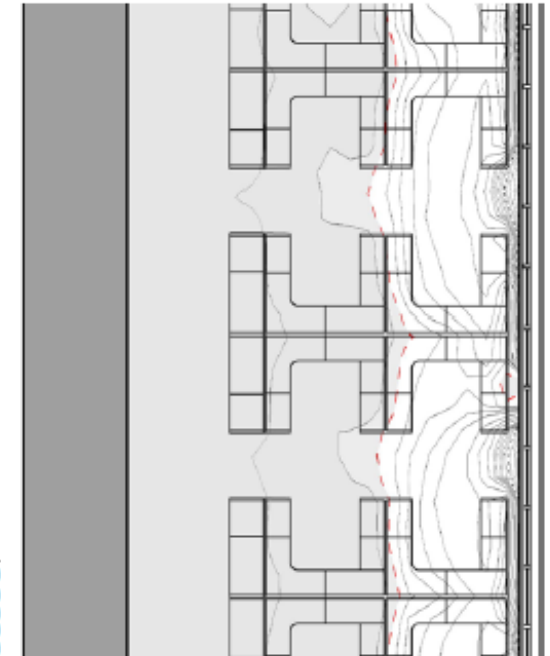
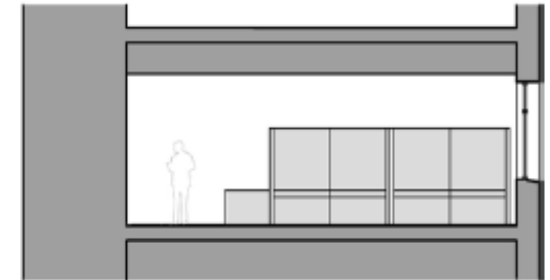
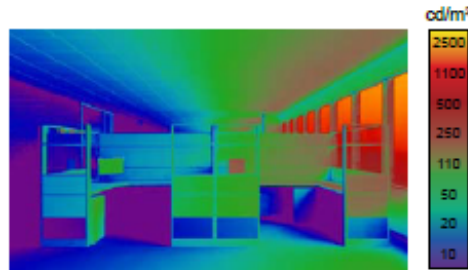
25%
of floor area is
above 300 lux



Pattern 5.9: Interior Furniture Layout

72" Panels with Glass Partitions

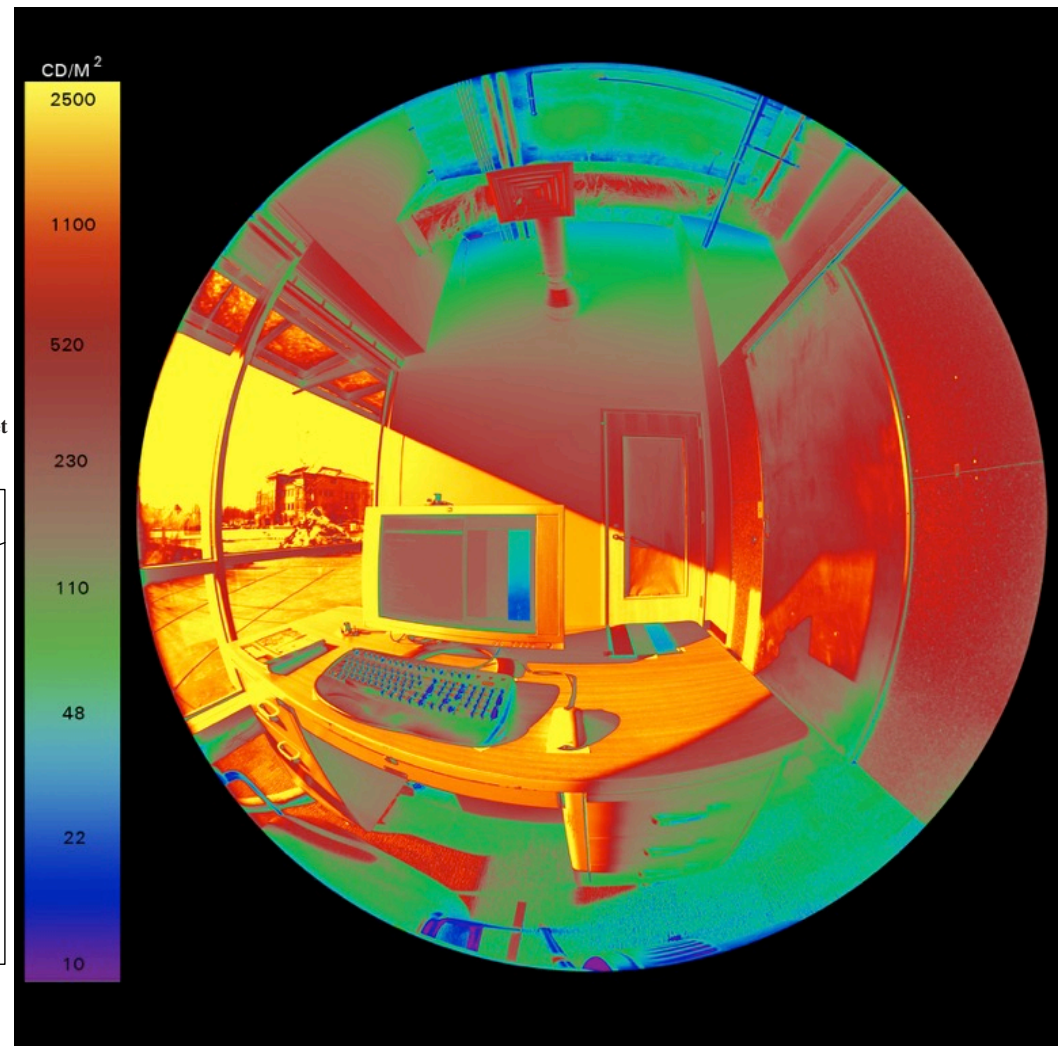
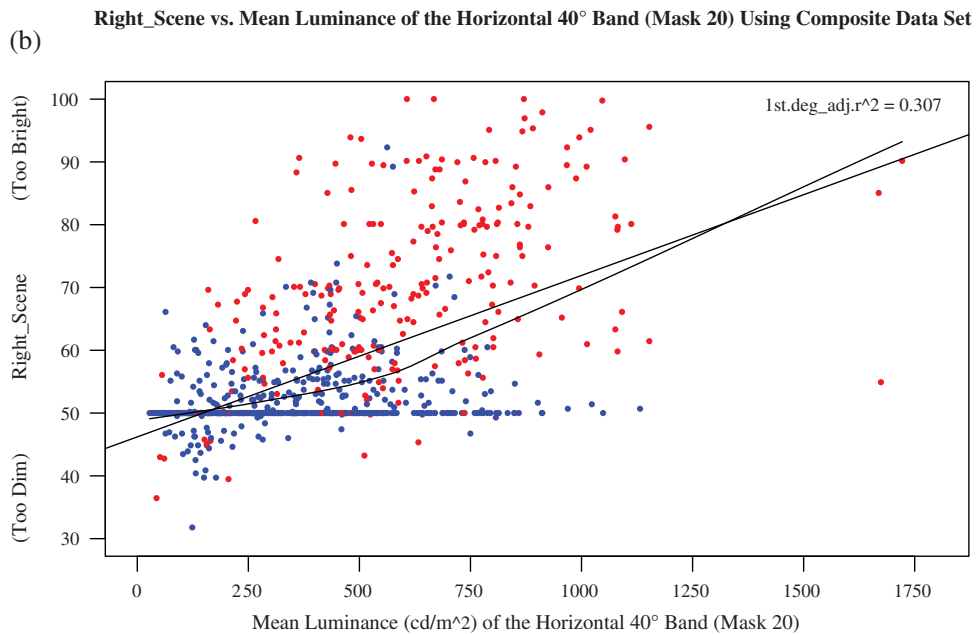
Changing the materiality of the workstation panels parallel to the glazing to be transparent allows daylight distribution and views despite the 72" panel height. However, horizontal daylight levels exceed commonly accepted ambient illumination criteria only directly adjacent to the perimeter glazing.



thank you NBI

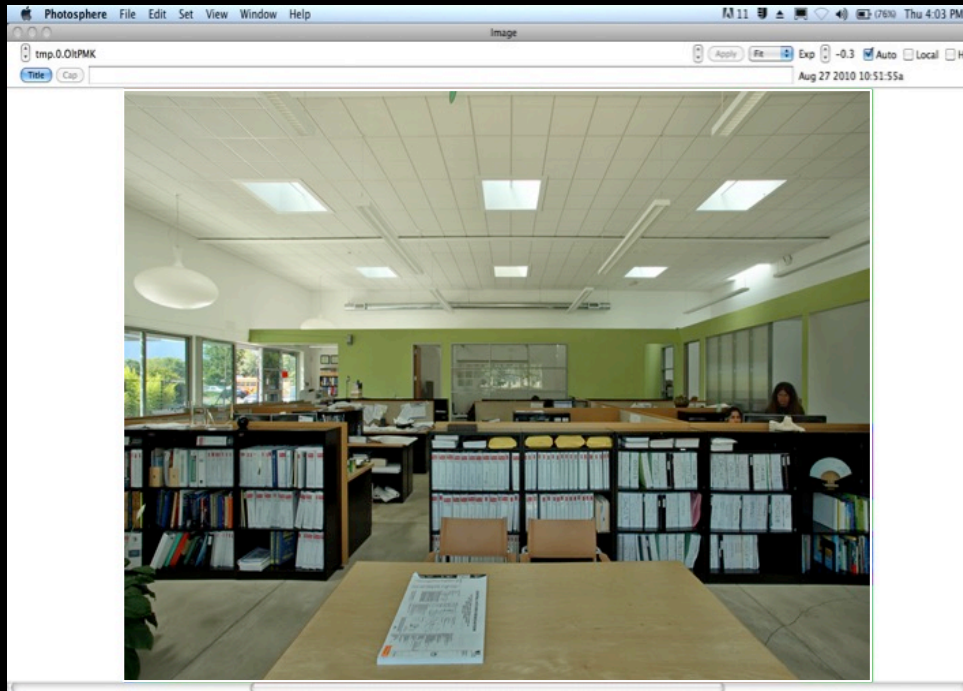
high dynamic range imaging

thank you MInanici

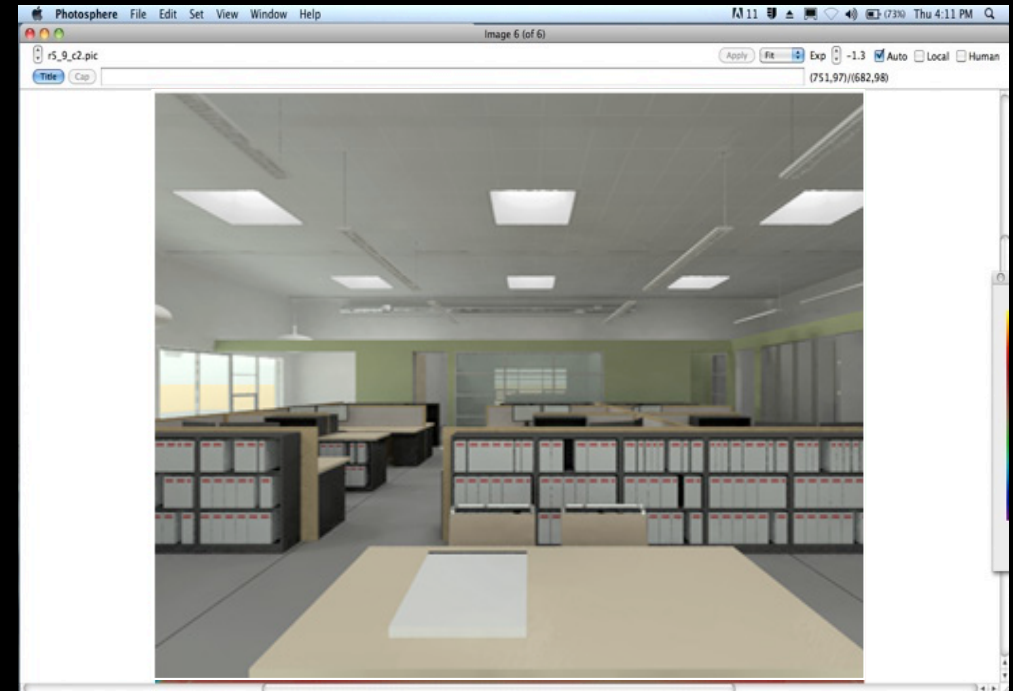


high dynamic range imaging

Simulation/Validation Tool: IDeAs Office Building (EHDD Architects)



HDR Photo from
Site Visit

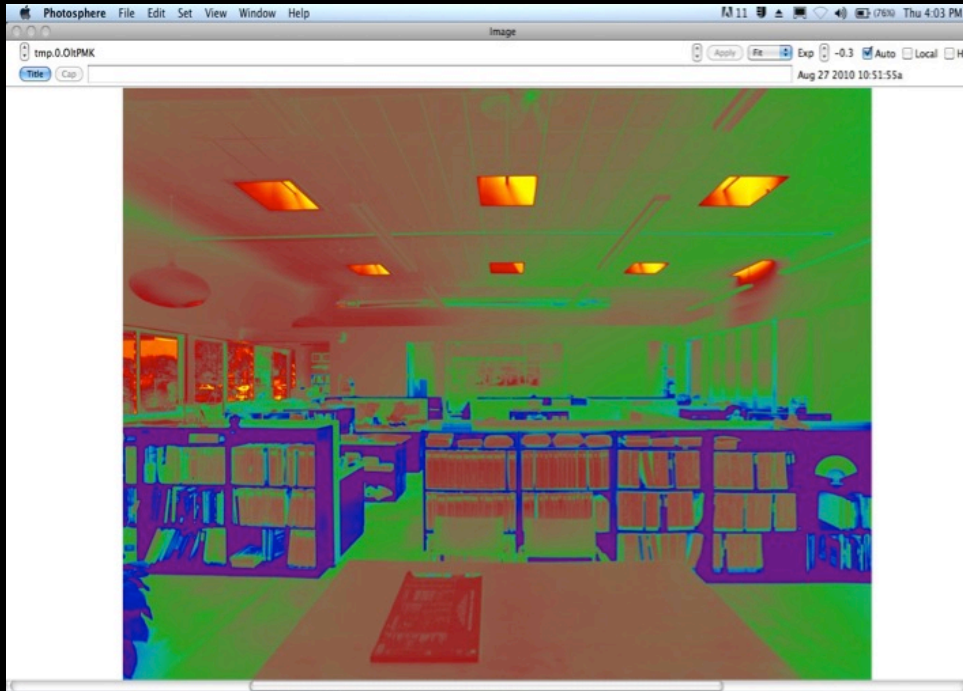


Visualization from
Radiance Model

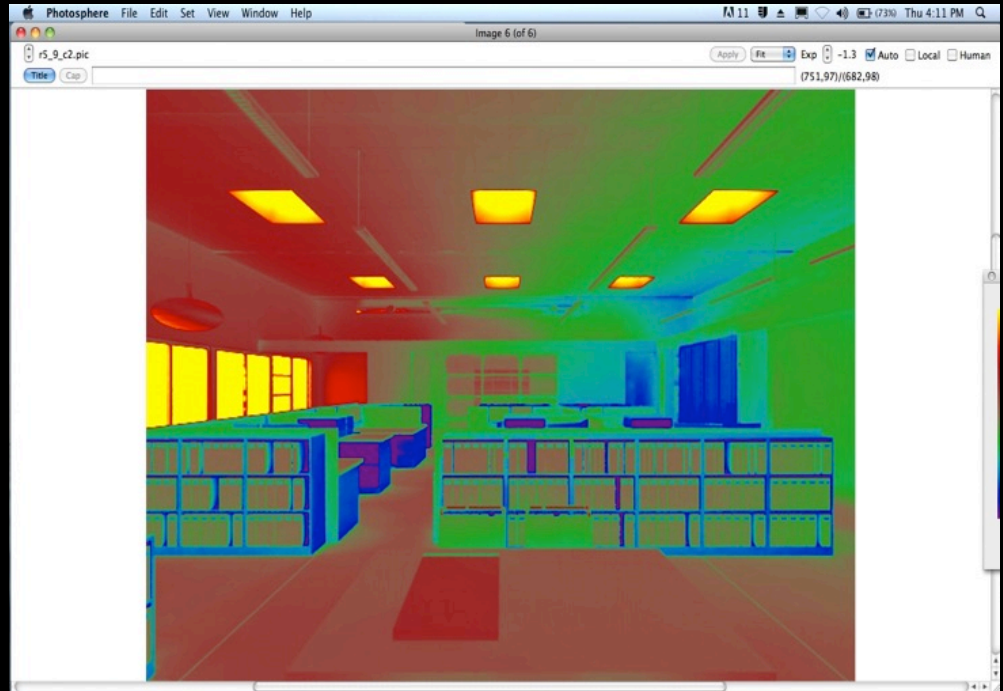
thank you CMeek

high dynamic range imaging

Simulation/Validation Tool: IDeAs Office Building (EHDD Architects)



Luminance Data
from Site Visit

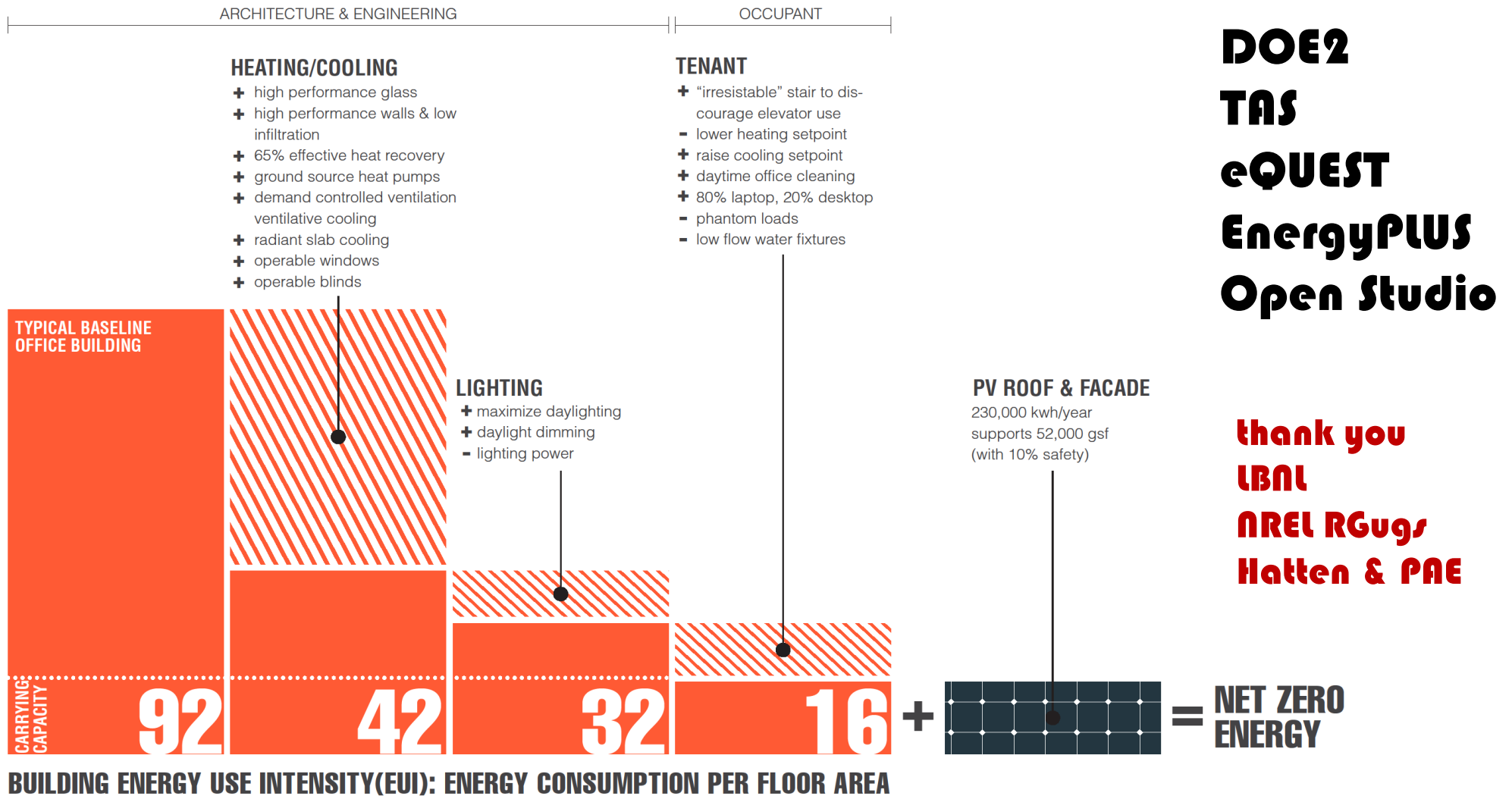


Luminance Data from
Radiance Model

(Images both scaled 10-2500 cd/m²)

Courtesy Meek

iterative energy simulation

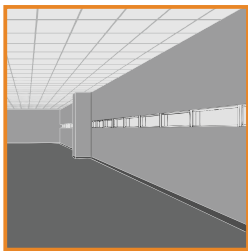
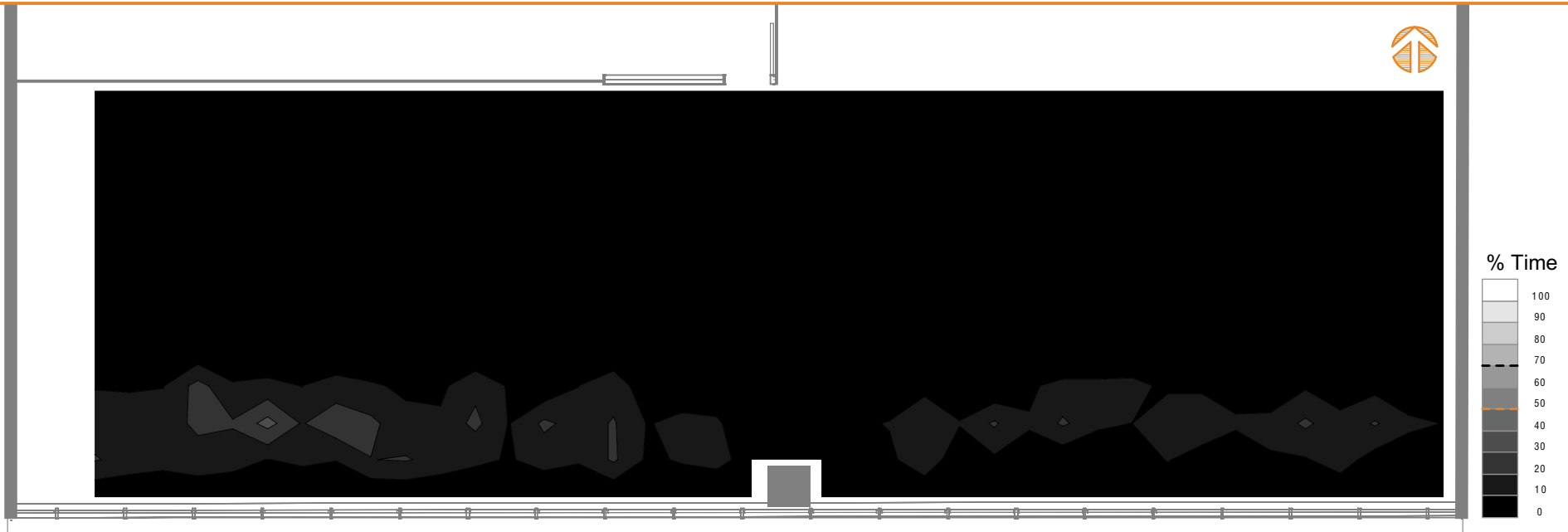


THE PATH TO NET ZERO ENERGY

Courtesy: Meek / Bullitt Foundation / PAE

coupled energy simulation

Daylight Autonomy - Banner Bank, pattern 2.1
Boise, ID - South orientation - No blinds operation
10% window to wall ratio



10% WWR
08:00-18:00

0%

of the sensors are
above DA_{300} at least
50% of the time.

2.8% (Avg DA)

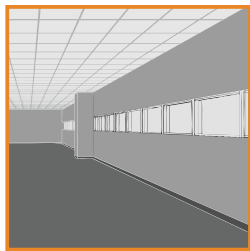
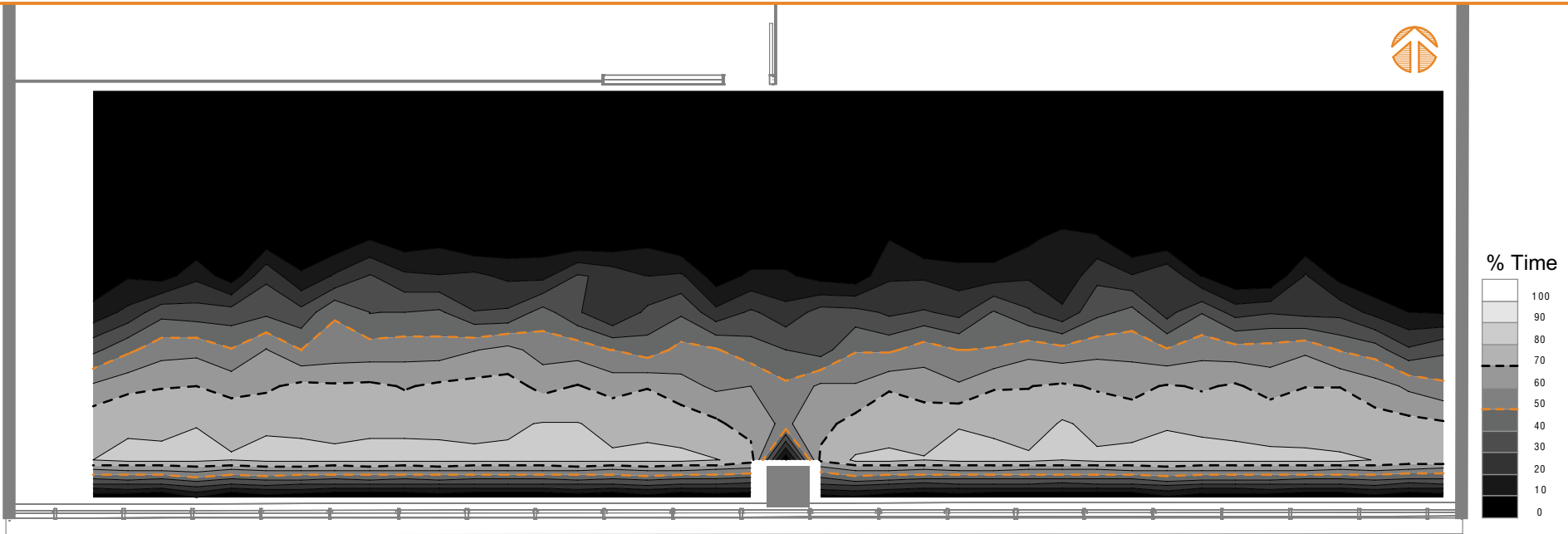
spatial Daylight Autonomy
(no blinds)

EUI **50**
kBTU/SF*
YR

51

Daylight Autonomy - Banner Bank, pattern 2.1

Boise, ID - South orientation - No blinds operation
20% window to wall ratio



20% WWR
08:00-18:00
32.2%
of the sensors are
above DA_{300} at least
50% of the time.
27.0% (Avg DA)

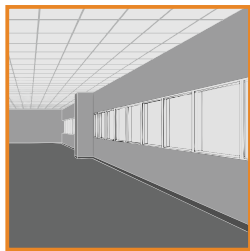
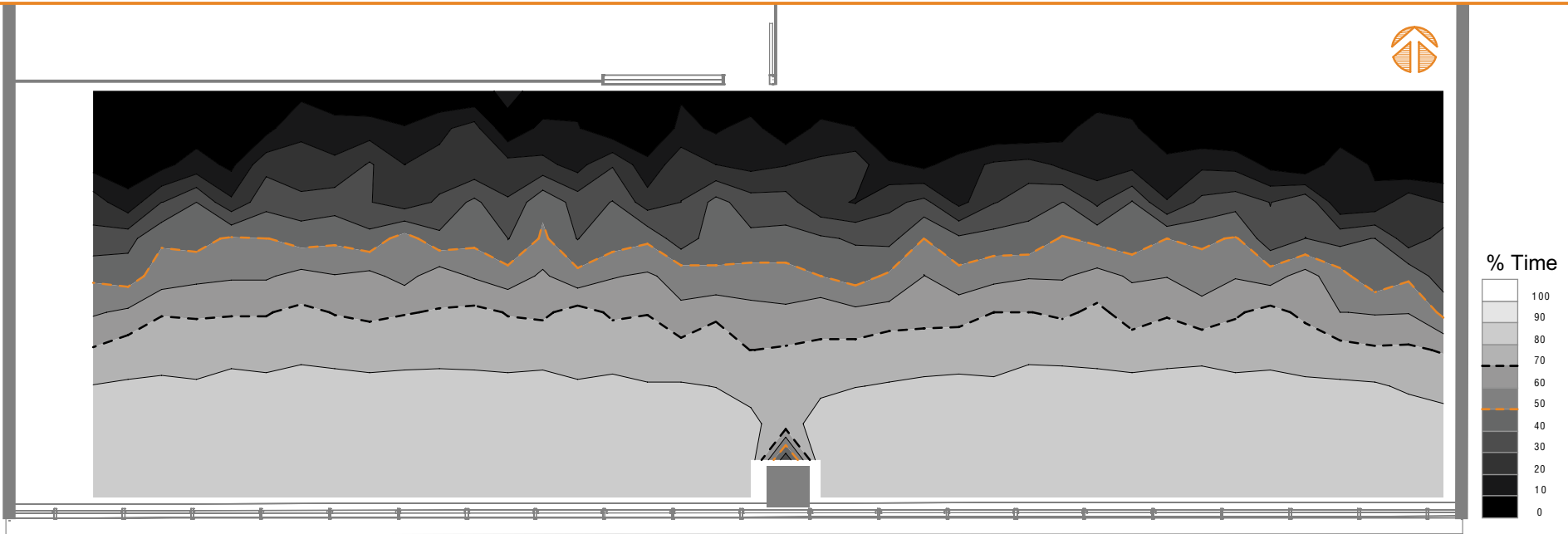
spatial Daylight Autonomy
(no blinds)

EUI 47
kBTU/SF*
YR

52

Daylight Autonomy - Banner Bank, pattern 2.1

Boise, ID - South orientation - No blinds operation
30% window to wall ratio



30% WWR
08:00-18:00
57.5%
of the sensors are
above DA_{300} at least
50% of the time.
52.7% (Avg DA)

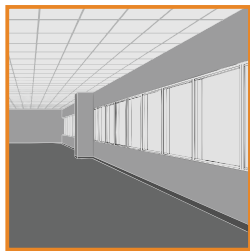
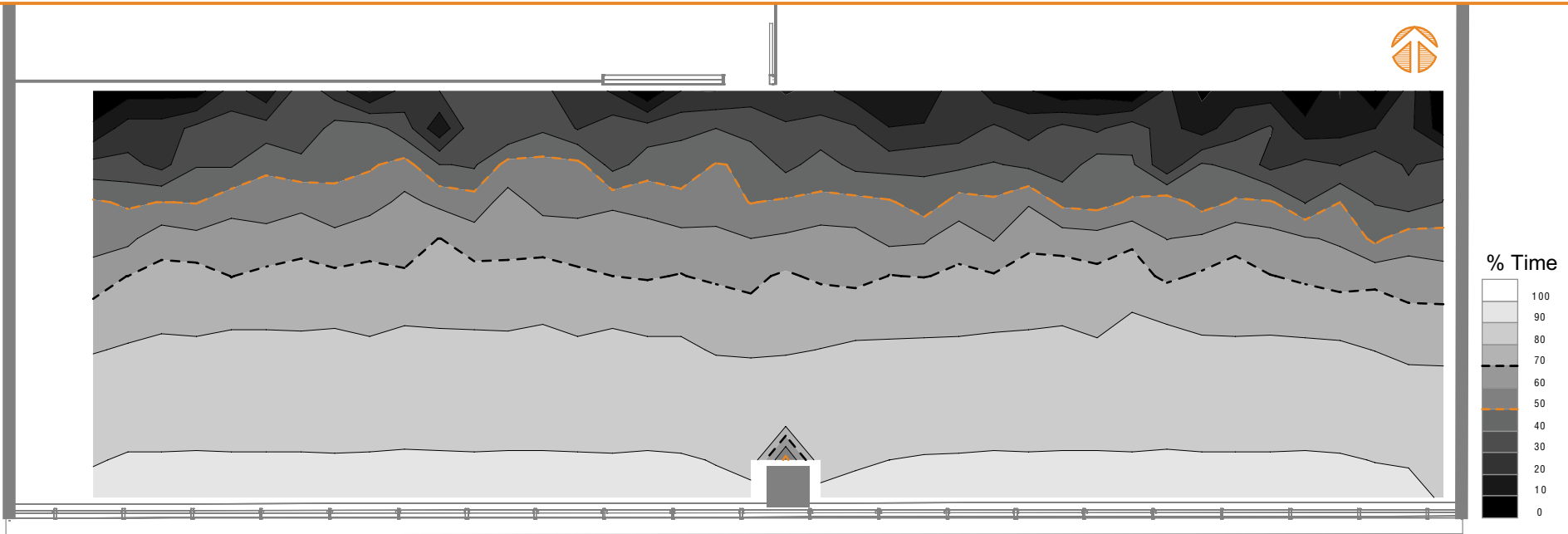
spatial Daylight Autonomy
(no blinds)

EUI 47
kBTU/SF*
YR

53

Daylight Autonomy - Banner Bank, pattern 2.1

Boise, ID - South orientation - No blinds operation
40% window to wall ratio



40% WWR
08:00-18:00
72.9%
of the sensors are
above DA_{300} at least
50% of the time.
65.0% (Avg DA)

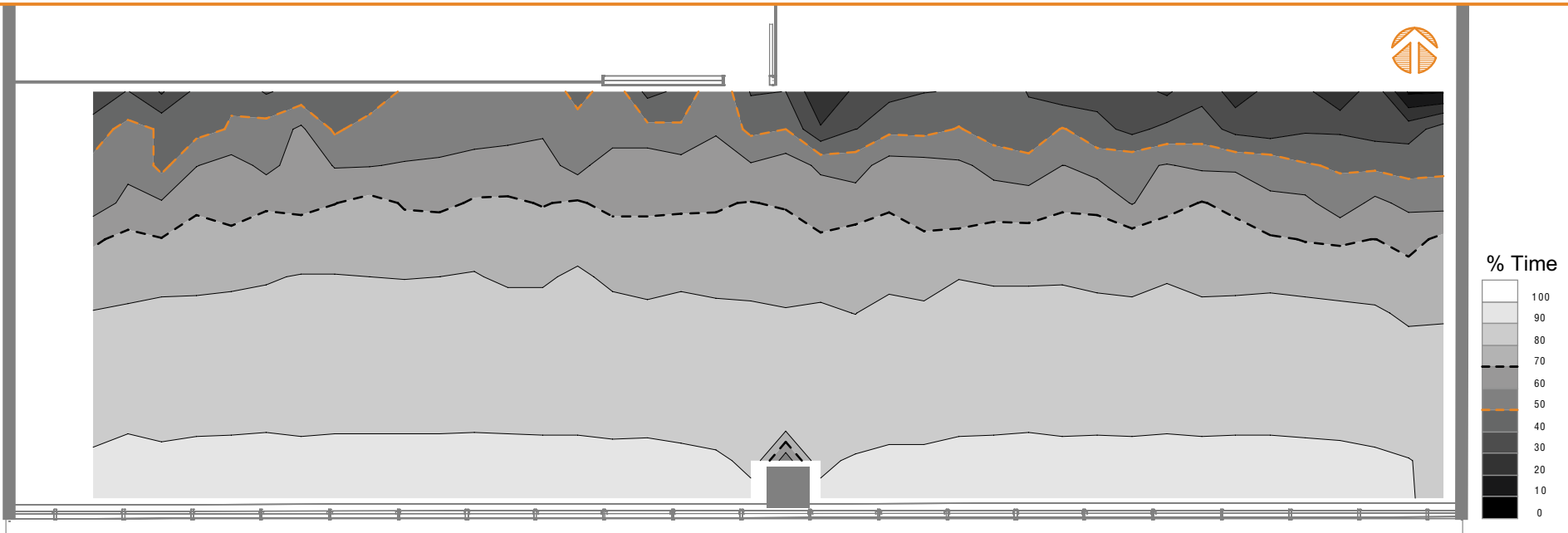
spatial Daylight Autonomy
(no blinds)

EUI 47
kBTU/SF*
YR

55

Daylight Autonomy - Banner Bank, pattern 2.1

Boise, ID - South orientation - No blinds operation
50% window to wall ratio



50% WWR
08:00-18:00
87.3%
of the sensors are
above DA_{300} at least
50% of the time.
73.8% (Avg DA)

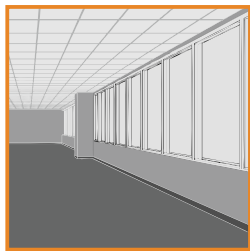
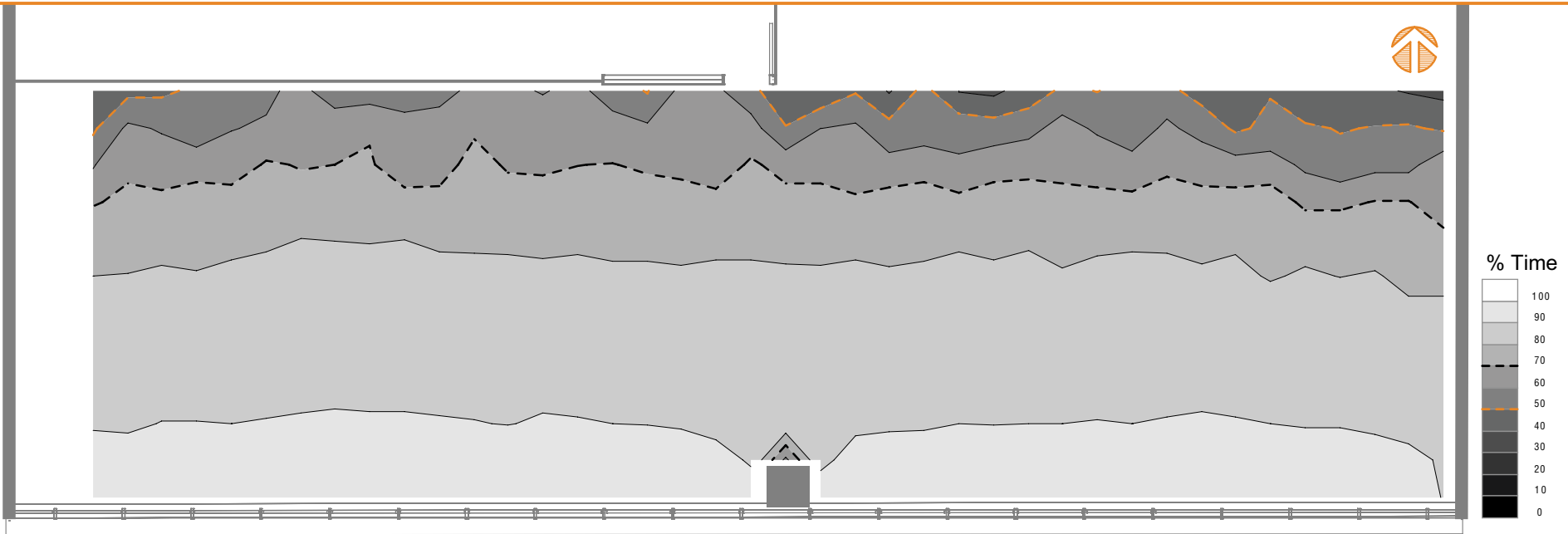
spatial Daylight Autonomy
(no blinds)

EUI 48
kBTU/SF*
YR

57

Daylight Autonomy - Banner Bank, pattern 2.1

Boise, ID - South orientation - No blinds operation
60% window to wall ratio



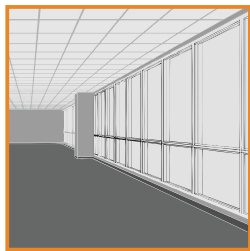
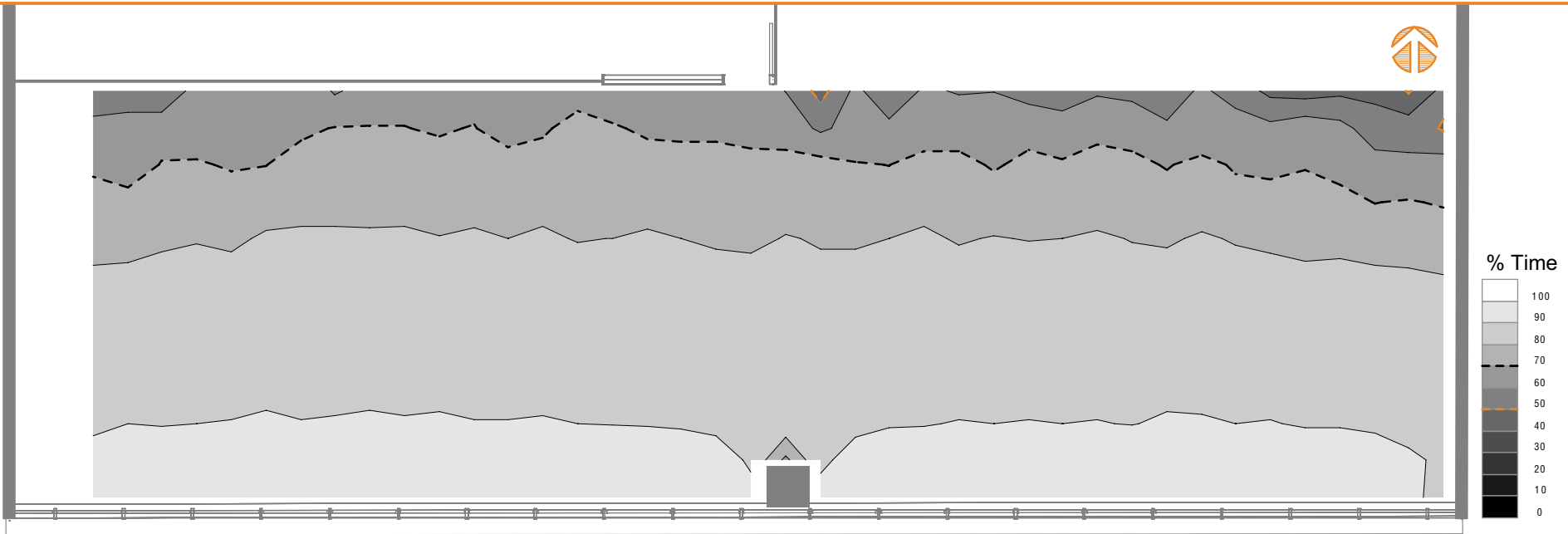
60% WWR
08:00-18:00
94.8%
of the sensors are
above DA_{300} at least
50% of the time.
78.1% (Avg DA)

spatial Daylight Autonomy
(no blinds)

EUI 49
kBTU/SF*
YR

60

Daylight Autonomy - Banner Bank, pattern 2.1
 Boise, ID - South orientation - No blinds operation
 75% window to wall ratio



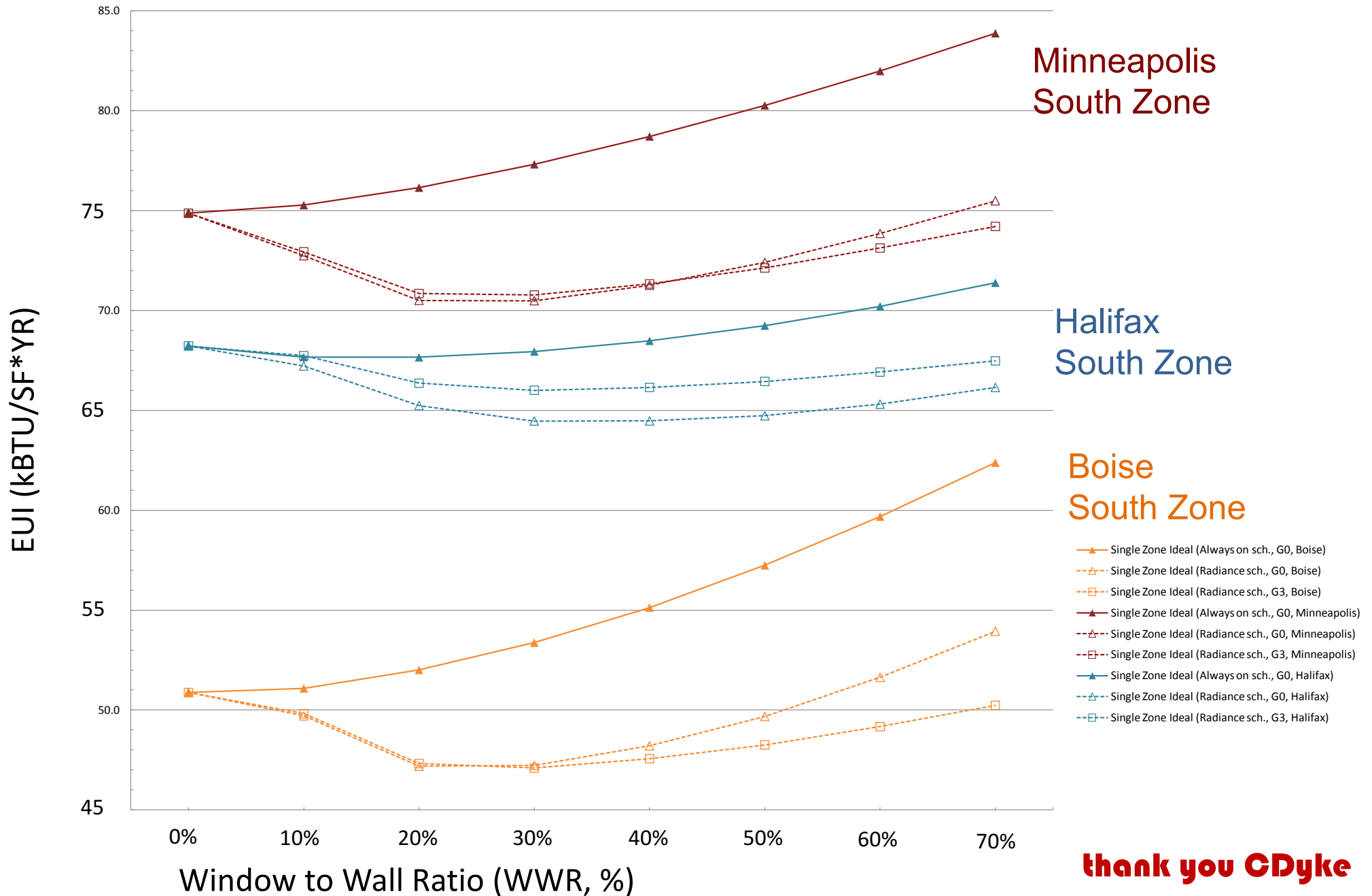
75% WWR
 08:00-18:00
98.3%
 of the sensors are
 above DA_{300} at least
 50% of the time.
 80.4% (Avg DA)

spatial Daylight Autonomy
 (no blinds)

EUI **50**
 kBTU/SF*
 YR

65

Energy Use w/wo Daylight Harvest



thank you CDyke

thank you Anezamdoost

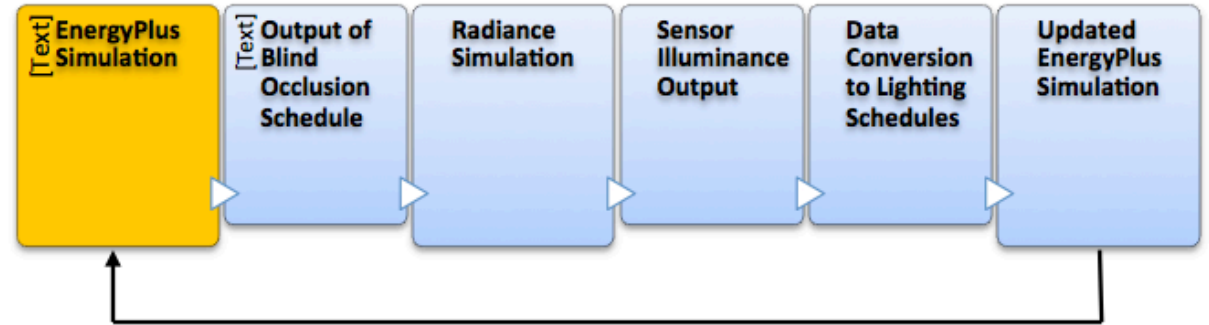
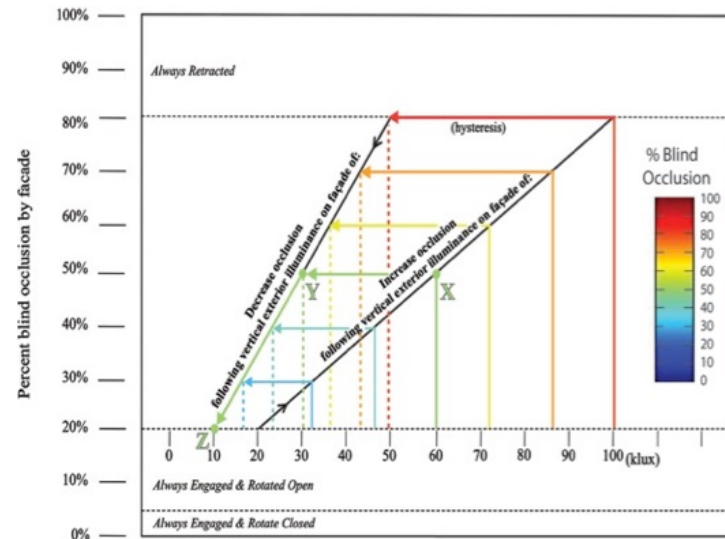
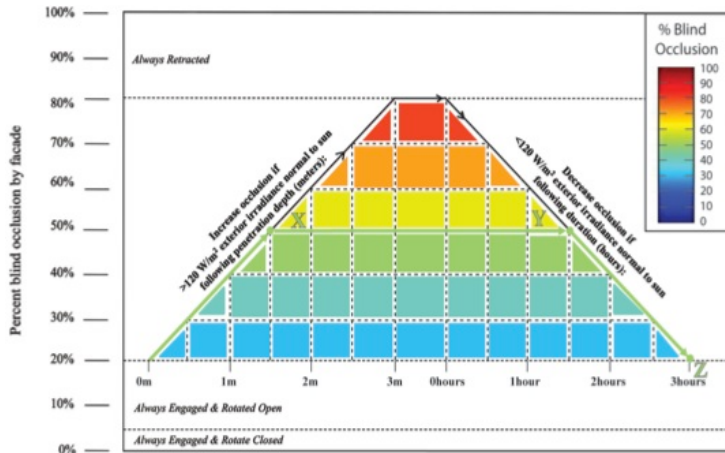


Figure 2-10: EnergyPlus/ Radiance integration workflow for Blindswitch-A

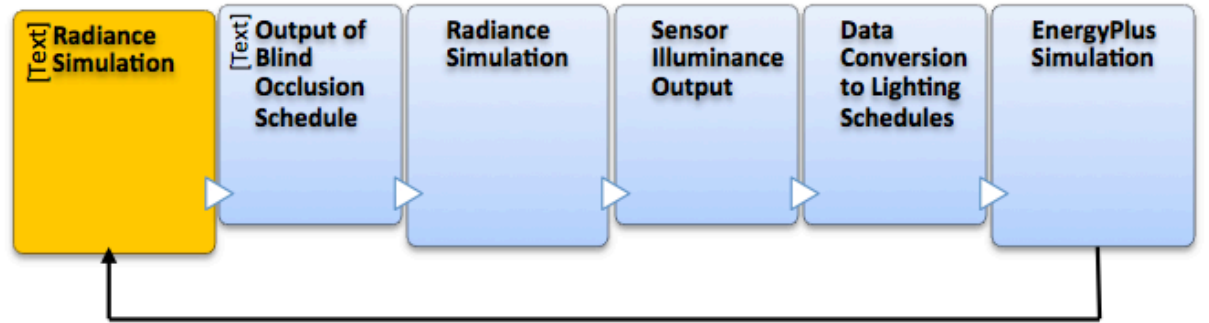


Figure 2-11: EnergyPlus/ Radiance integration workflow for Blindswitch-B

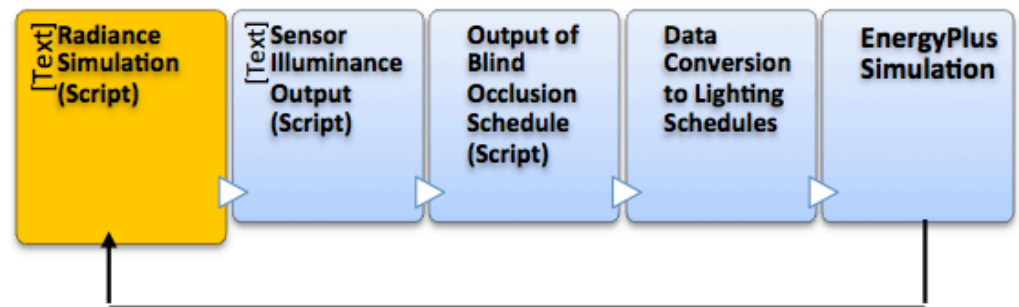
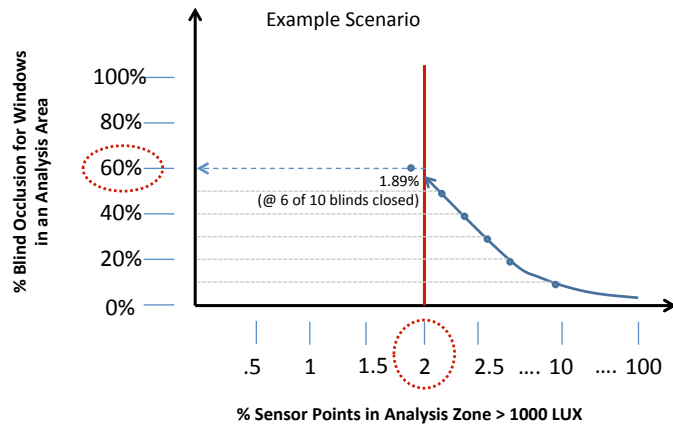
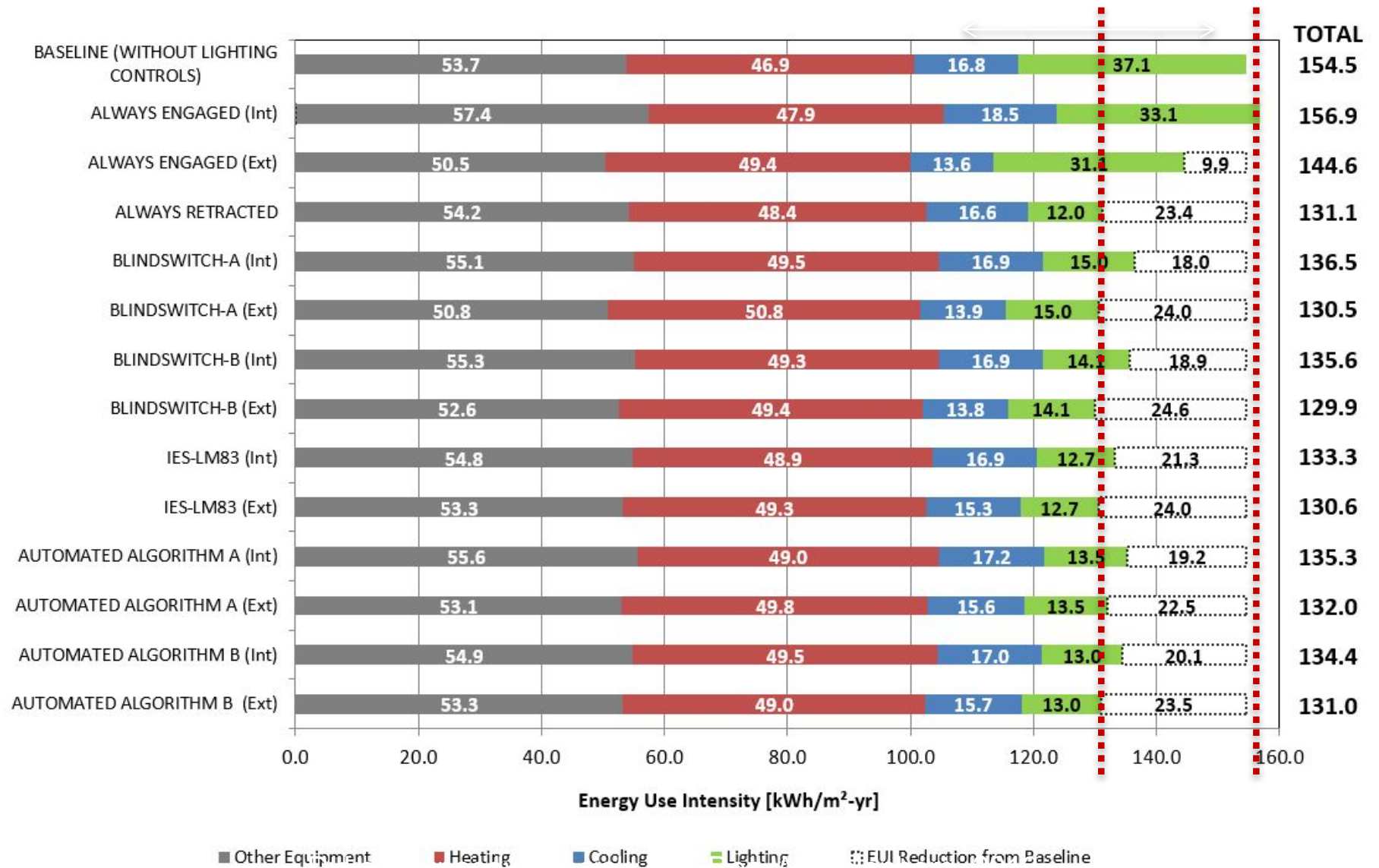


Figure 2-12: EnergyPlus/ Radiance integration workflow for LM-83



Energy Impact? Up to 18%



thank you IES-DMC & Uteschong

IES LM-83-12 Approved Method:

Spatial Daylight Autonomy (sDA)

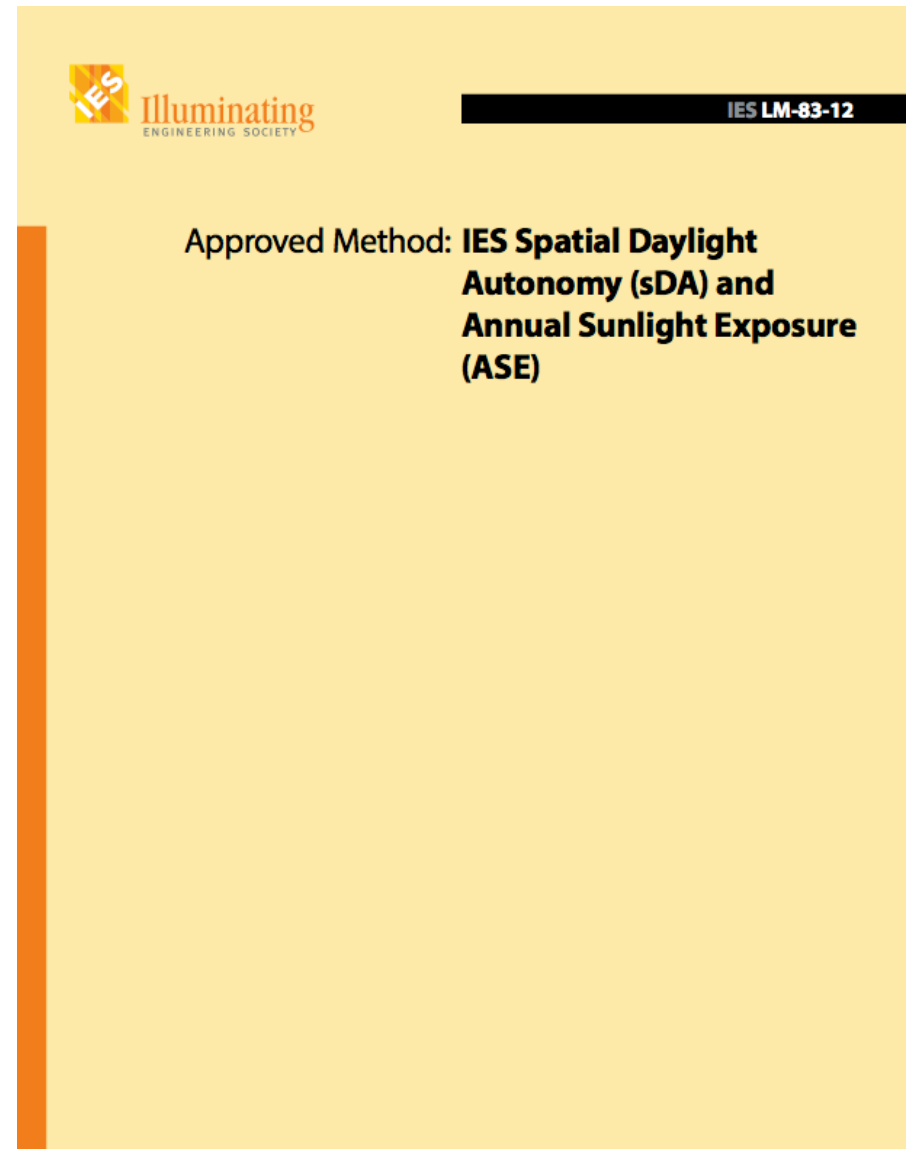
Is there enough daylight in the space? (measured using annual hourly illuminance):

- During analysis hours (8am-6pm)
- What % of floor area exceeds 300 lux for at least 50% of analysis hours?
- Exceed 55% of the floor area for “nominally acceptable daylight”
- Exceed 75% of the floor area for “preferred daylight”

Annual Sunlight Exposure (ASE)

Is there excessive daylight in the space (measured using annual hourly illuminance):

- During analysis hours (8am-6pm)
- What % of the floor area exceeds 1000 lux “computational direct sunlight” (sun spots) for more than 250 annual analysis hours?
- Below 10% of the floor area for less discomfort, lower is better
- Exceeding 20% of the floor area suggests need for automated blinds or additional fixed shading strategies



The slide features a yellow background with a black header bar on the right containing the text "IES LM-83-12". In the top left corner, there is the IES logo (a yellow square with "IES" in white) and the text "Illuminating ENGINEERING SOCIETY" in orange and black. The main content is centered and reads: "Approved Method: **IES Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE)**". A vertical orange bar is positioned on the left side of the slide.

Biology and the Built Environment Center

BioBE Center University of Oregon

Jessica L. Green
Kevin Van Den Wymelenberg
Co-directors BioBE

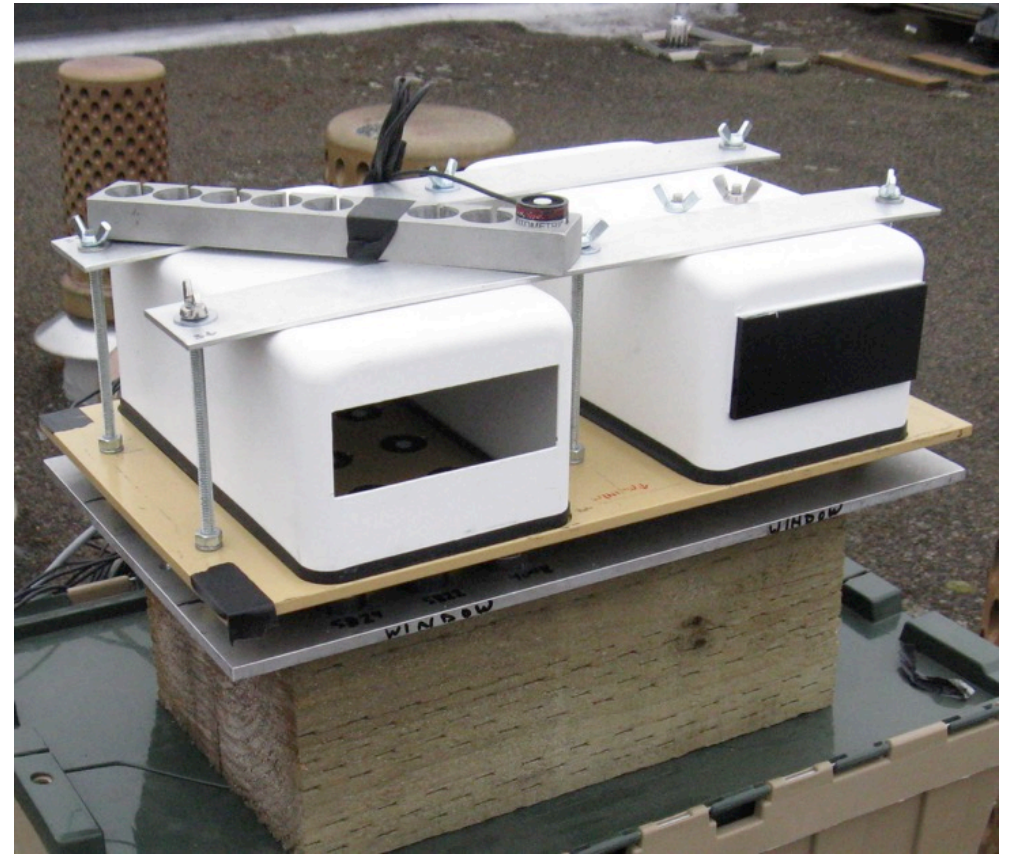
Biology & Built Environment Center
University of Oregon
<http://biobe.uoregon.edu/>



thank you JGreen



Dust Microbial Communities have Dosage-Dependent Responses to Daylight



How can architects reshape the microbiome?

thank you Afahimipour & BioBE Team



thank you AP.Sloan

Health Design: IAQ, microbial characterization & dispersal, hygiene, antibiotic resistance, materials disclosure

OPTIMIZE HEALTH

Energy Design: daylighting, natural ventilation, and other load reduction & EE strategies

BALANCE ENERGY



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**EXPLORING THE BUILT ENVIRONMENT:
A COLLABORATION BETWEEN
INDUSTRY AND UNIVERSITY**

presented by

**Energy Studies in
Buildings Laboratory**



**Biology and the Built
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TALLWOOD
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9. M. Riggio – OSU
10. A. Barbosa – OSU
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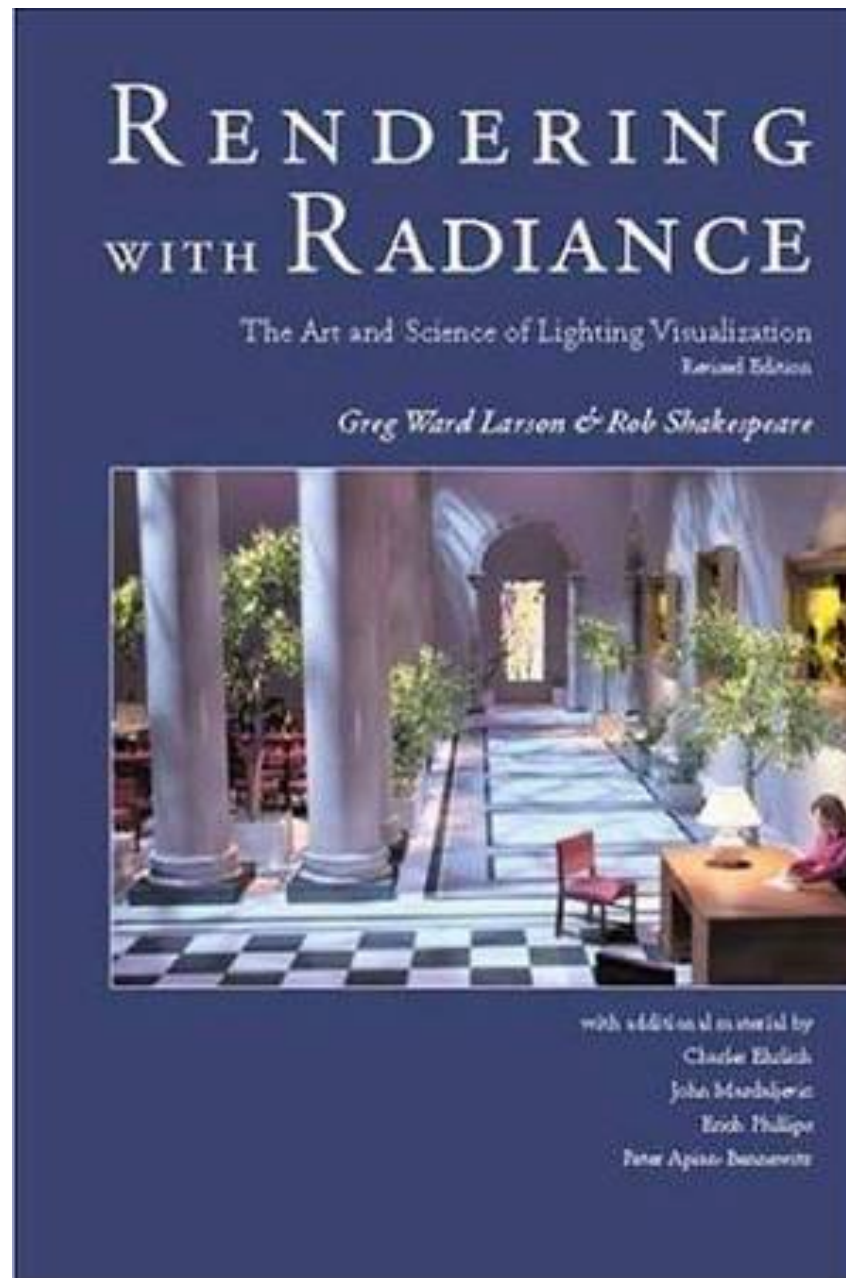


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12. Daniel Roth
13. Maria Sarao
14. Paul Ward



<https://www.amazon.com/Rendering-Radiance-Science-Lighting-Visualization/dp/0974538108>



thank you Char Ehrlich



Thank you Greg Ward & the Radiance Community!